UKCS Licence P585,
Block 15/12b
Relinquishment Report

Contents

1 Licence Information

This report documents the relinquishment of licence P585, awarded to Texaco Britain Limited and Clyde Petroleum plc in the UK 10th licence round as UK Block 15/12b in 1987. The location and current extent of the licence area can be seen in ; a brief summary of the licence is presented in Table 1-1.

Licence Number	P585
Licence Round	10th Seaward Licensing Round
Licence Type	Traditional
Block Number(s)	15/12b
Operator / Partners (%)	EnQuest Heather Ltd (60%), Talisman Sinopec Energy UK Limited (3.33%), Transworld Petroleum (UK) Limited (36.67%)

Table 1-1: Licence information

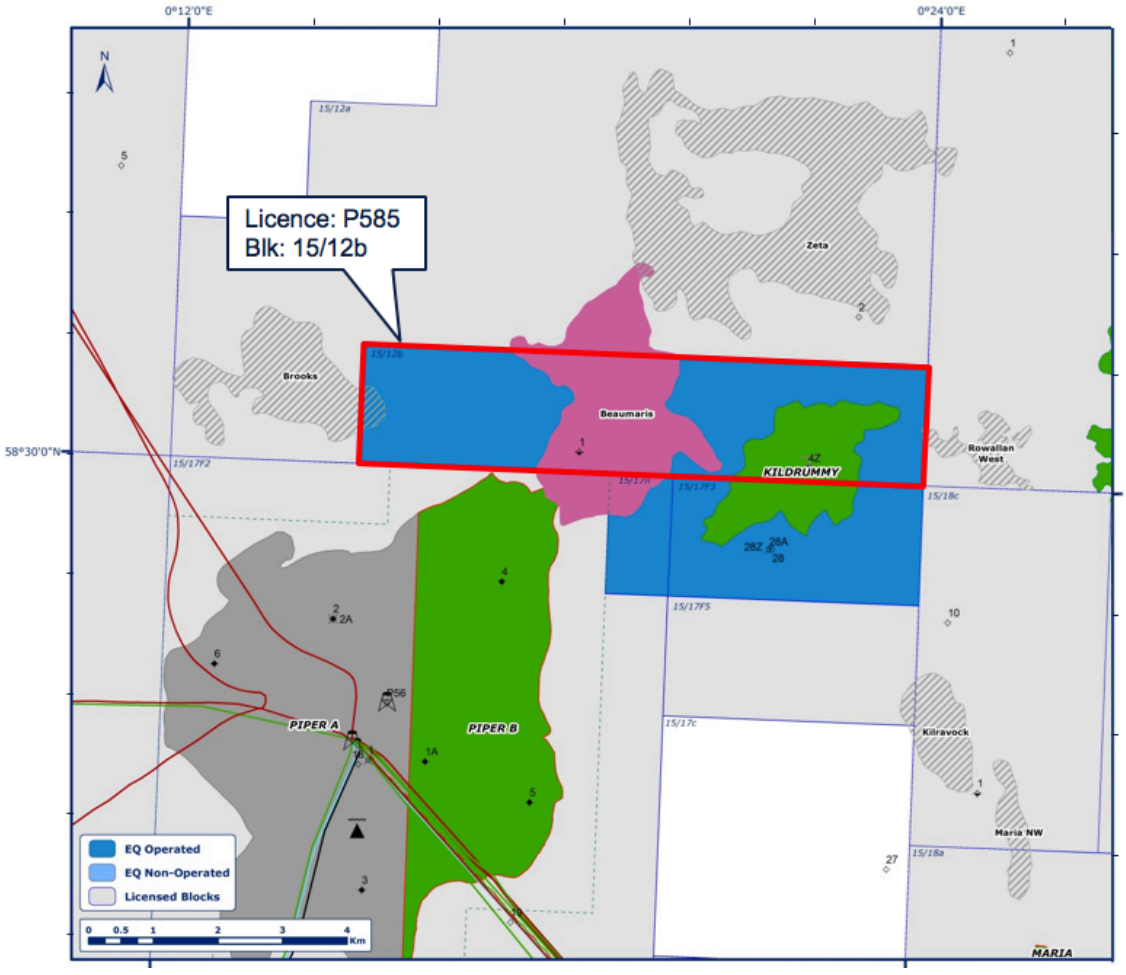


Figure 1-1: Licence P585 location map

2 Licence Synopsis

The licence was awarded to Texaco Britain Limited (operator) and Clyde Petroleum plc as part of the 10th Offshore Licence Round as a Traditional Licence with a start date of 4th June 1987. The licence covered 162 km^2 at award.

The firm work programme during the initial term was to "carry out not less than 300 kilometres of seismic survey work in the licenced area and drill therein one exploration well to a depth of not less than 1250 feet below the base of the Upper Jurassic or 100 feet into the Carboniferous whichever is the lesser depth."

The well commitment was discharged with the drilling of well 15/12b-2 in the 3Q 1987, which was dry. The acreage was part relinquished in 1993, retaining 79.2 km^2. There were a number of licencees changes between 1996 and 2001 (Table 2.1), with Talisman North Sea Limited becoming operator in December 1999.

The Lucy prospect was drilled in early 2001 by the 15/12b-4 well, which encountered oil in shallow marine Upper Jurassic sandstones, and the well was suspended (accumulation subsequently renamed Kildrummy). Talisman and partners acquired new 3D seismic over Kildrummy, as part of a larger group shoot, and submitted a Field Development Plan for Kildrummy in 2001. Prior to executing the development, they re-entered the well in 1H 2002 and drilled two appraisal sidetracks (15/12b-4z and 4y). The results were disappointing with top reservoir coming in deeper than expected and the Kildrummy development was cancelled. Additional acreage was relinquished in 2004, with 16.2 km^2 retained.

The seismic data was reprocessed twice to better image the Kildrummy Discovery. EnQuest farmed into the licence in 2012 as operator and ENI exited (Table 2.1). This was part of a larger farm-in since the Kildrummy Discovery extends over three part-blocks and licences, the other two being P220, Block 15/17n; P250, Block 15/17a.

As part of the farm-in deal, the Kildrummy Discovery was further appraised in 2012 by well 15/17a-28A with the top hole located in Block 15/17a to the south of 15/12b. The motherbore was TD'd within Block 15/17a, and a sidetrack (15/17a-28z) was drilled into Block 15/12b. Plans for a further sidetrack were abandoned based on the disappointing results of the two penetrations.

Date	Licencees	Equity	Comment
4th June 1987	Texaco Britain Ltd (op) Clyde Petroleum plc	66.67% 33.33%	
July 1987	Texaco Britain Ltd (op) Clyde Expro plc	66.67% 33.33%	Company name change
July 1996	Texaco Britain Ltd (op) Clyde Expro plc Union Texas Petroleum Ltd	46.67% 33.33% 20.00%	
May 1998	Texaco Britain Ltd (op)	46.67%	Corporate acquisition of Clyde

	Kerr-McGee Oil (UK) plc Union Texas Petroleum Ltd	33.33% 20.00%	
Jan 1999	Texaco Britain Ltd (op) Kerr-McGee Oil (UK) plc Arco British Ltd	46.67% 33.33% 20.00%	Corporate acquisition of Union Texas
Dec 1999	Talisman North Sea Ltd (op) Kerr-McGee Oil (UK) plc Arco British Ltd	46.67% 33.33% 20.00%	Part of larger asset purchase
Jan 2000	Talisman North Sea Ltd (op) Transworld Petroleum (UK) Ltd Kerr-McGee Oil (UK) plc Intrepid Energy DL Ltd Intrepid Energy NSL Ltd	16.67% 60.00% 20.00% 2.00% 1.33%	Talisman subsidiary - transfer
June 2000	Talisman North Sea Ltd (op) Transworld Petroleum (UK) Ltd LASMO North Sea plc Intrepid Energy DL Ltd Intrepid Energy NSL Ltd	16.67% 60.00% 20.00% 2.00% 1.33%	
July 2001	Talisman North Sea Ltd (op) Transworld Petroleum (UK) Ltd LASMO North Sea plc Talisman Energy (UK) Ltd	16.67% 60.00% 20.00% 3.33%	
Apr 2003	Talisman North Sea Ltd (op) Transworld Petroleum (UK) Ltd ENI ULX Limited Talisman Energy (UK) Ltd	16.67% 60.00% 20.00% 3.33%	Corporate acquisition of LASMO
July 2003	Talisman North Sea Ltd (op) Transworld Petroleum (UK) Ltd ENI UK Limited Talisman Energy (UK) Ltd	16.67% 60.00% 20.00% 3.33%	Company name change
Aug 2012	EnQuest Heather Ltd (op) Transworld Petroleum (UK) Ltd Talisman Energy (UK) Ltd	60.00% 36.67% 3.33%	EnQuest farm-in
Dec 2012	EnQuest Heather Ltd (op) Transworld Petroleum (UK) Ltd Talisman Energy (UK) Ltd Addax Petroleum	60.00% 36.67% 1.70% 1.63%	
Jan 2013	EnQuest Heather Ltd (op) Transworld Petroleum (UK) Ltd Talisman Energy (UK) Ltd	60.00% 36.67% 3.33%	
Dec 2013	EnQuest Heather Ltd (op) Transworld Petroleum (UK) Ltd Talisman Sinopec Energy (UK) Ltd	60.00% 36.67% 3.33%	Company name change / Joint venture
Jul 2016	EnQuest Heather Ltd (op) Transworld Petroleum (UK) Ltd Repsol Sinopec Resources (UK) Ltd	60.00% 36.67% 3.33%	Corporate acquisition of Talisman by Repsol

Table 2-1: Licence partnership changes

3 Work Programme Summary

Work programme Firm Commitment

The Licensee shall: carry out not less than 300 kilometres of seismic survey work in the licenced area and drill therein one exploration well to a depth of not less than 1250 feet below the base of the Upper Jurassic or 100 feet into the Carboniferous whichever is the lesser depth.

The firm work commitment was fulfilled by Texaco in 1987 with the drilling of the 15/12b-2 well.

4 Database

4.1 Well Database

EnQuest and Talisman-Sinopec had access to an extensive well database in the region. Talisman-Sinopec operates the nearby Piper, Saltire, Iona and Chanter fields, which contain Upper Jurassic shallow marine reservoirs. The key wells relevant to the interpretation of the block are shown in Table 4-1, which includes well reports, composite logs and wireline log data. All the relevant released well data in the surrounding acreage was acquired from CDA and analysed.

Well	Field / Disc	Status	Date	TD (ft)	TD Fm	Operator	Core	Velocities	RFT/ MDT
15/12b-1	Beaumaris	Oil shows*	1973	-9,853	Zechstein	Burmah	No	No	No
15/12b-2	-	Dry	1987	-9,934	Carboniferous	Texaco	No	VSP	No
15/12b-4	Kildrummy	Oil	2001	-8,945	Piper	Talisman	Kildrummy	VSP	Yes
15/12b-4z	Kildrummy	Oil	2002	-8,664	Kildrummy	Talisman	No	VSP	No
15/12b-4y	Kildrummy	Oil	2002	-8,688	Kildrummy	Talisman	No	VSP	No
15/17a-28A	Kildrummy	Oil	2012	-8,657	Kildrummy	EnQuest	No	VSP	No
15/17a-28z	Kildrummy	Oil	2012	-8,575	Kildrummy	EnQuest	No	No	No
15/13-1	-	Dry	1974	-8,895	Carboniferous	BP	No	Checkshot	Yes
15/13-2	Hood	Oil	1975	-7,825	Carboniferous	BP	No	Checkshot	Yes
15/13a-10	Pardis	Oil	2008	-6,913	Fladen	IOC	No	Yes	Yes
15/17-4	Piper	Oil	1973	-9,345	Zechstein	Occidental	Piper	Velocity	No
15/17-5	Piper	Oil	1973	-9,707	Zechstein	Occidental	Piper	Yes	Yes
15/18-1	-	Oil shows	1974	-9,575	Carboniferous	Shell	Multiple	Velocity	No
15/18b-3	-	Oil shows	1985	-8,035	Carboniferous	BP	Montrose Gp	Velocity	Yes
15/18b-4A	-	Dry	1985	-8,213	Rattray	BP	Pentland	Velocity	Yes
15/18-5	-	Dry	1985	-7,867	Fladen	BP	Multiple	No	Yes
15/18a-7	Maria	Oil shows	1989	-12,333	Rattray	Shell	Multiple	Checkshot	Yes
15/18a-8	-	Dry	1992	-6,075	Mey	Shell	No	No	Yes
15/18b-10	-	Dry	2013	-9,063	Rattray	Encana	No	VSP	No
15/18b-11	Yeoman	Oil & Gas	2005	-7,320	Rattray	Nexen	No	VSP	Yes
15/18a-12	Maria	Oil & Gas	2008	-5,779	Mey	Petro-Canada	No	No	Yes
15/19b-10	Stag	Dry	2003	-9,063	Tor	Nexen	Balmoral	No	Yes

* Well status is Dry with oil shows, however, well contains the Beaumaris Discovery

Table 4-1: Offset well data summary

4.2 Seismic Database

The 3D seismic database that EnQuest used over this licence and for the evaluation of the more extensive Kildrummy Discovery were obtained from the previous operator, Talisman Sinopec, with the exception of the Fugro survey. The surveys are detailed in Table 4-2 and Figure 4-2.

Survey	Processing	2D/3D	Notes
FCA 3D PSDM (TB013D001)	2008 reprocessing	3D	Reprocessed by CGGV.
GXT Kildrummy PSDM	2009 reprocessing	3D	Reprocessed of NW corner of FCA survey covering Piper Field & Kildrummy. Only Kildrummy area available to EnQuest.
Fugro PSTM+	2008 merge & reprocessing	3D	Merged and reprocessed surveys. EnQuest only licenced data in parts of blocks 15/12, 15/13, 15/17, and 15/18.

Table 4-2: Seismic data summary

The base survey for evaluation of the Kildrummy Discovery was the Talisman FCA 2002. This was a propriety survey acquired by PGS on behalf of Talisman and partners over the Flotta Catchment Area on Talisman's acquisition of the surrounding FCA assets (Claymore, Piper, Tartan, Highlander, and Saltire platforms).

This survey was reprocessed in 2008 to PSDM, but this failed to give sufficient uplift in quality over the Kildrummy Discovery. As a result, a small part of the survey covering Piper Field and Kildrummy was reprocessed to PSDM to address the poor imaging and velocity issues at Kildrummy. EnQuest only had access to the part of this survey over Kildrummy as shown in Figure 4.2

The GXT Kildrummy reprocessing achieved the following:

- Improved shallow channel model;
- Partly resolved shallow velocity anomaly by tomography;
- Improved overburden model;
- Improved anisotropy below the chalk;
- Use of Beam migration enhanced the signal to noise ratio at the target depth with significant uplift in imaging below the target.

However, the following issues remaining unresolved:

- Unresolved anomaly in the overburden due to complex velocities changes, although it has been shown not to significantly affecting the bulk imaging;
- Imaging issues at Kildrummy are due to changes in the reflectivity (very thin to absent KCF) and cannot be further improved by velocity modelling in the overburden.

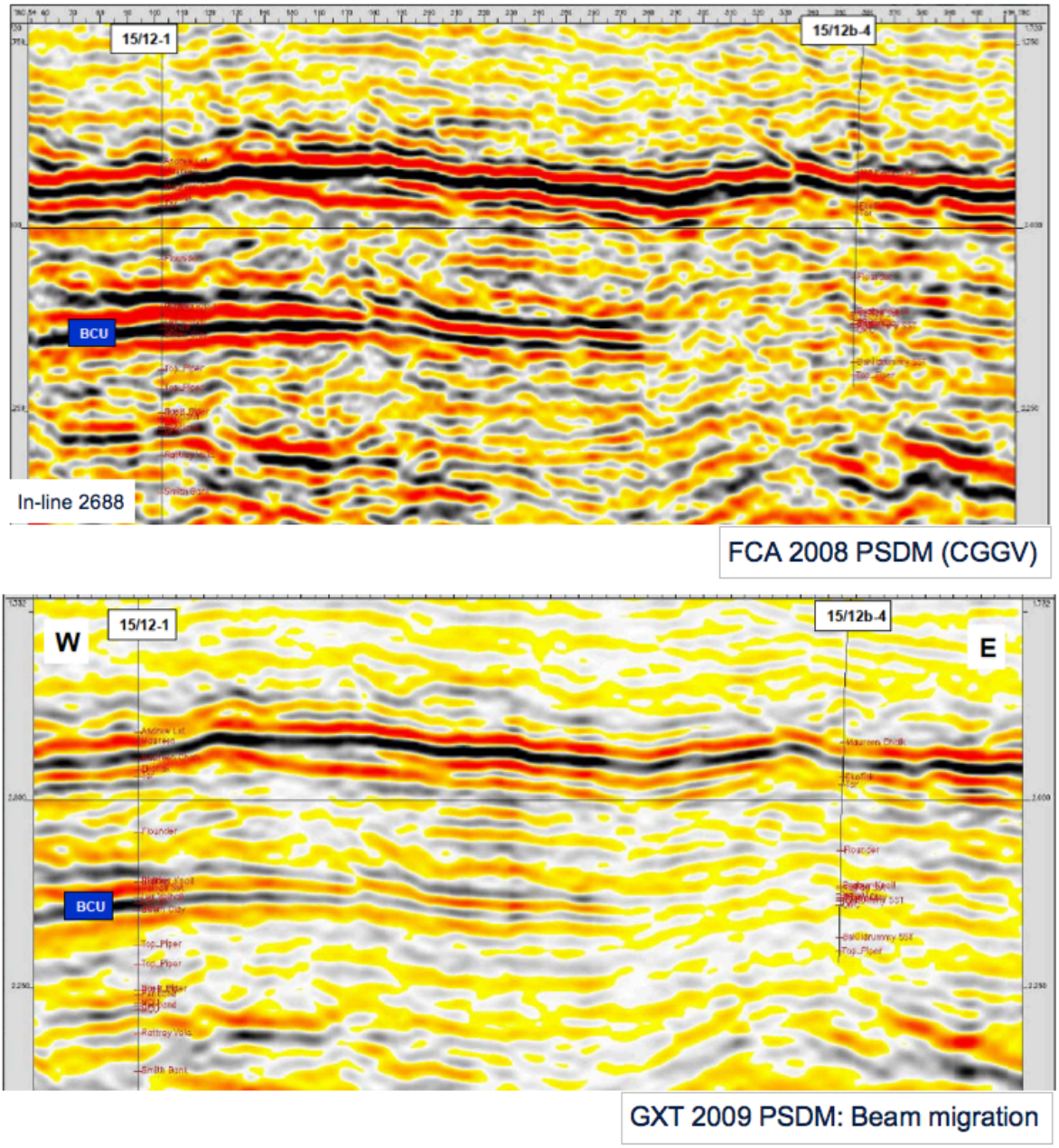


Figure 4-1: Comparison of X-line from FCA 2008 PSDM with GXT Kildrummy 2009 PSDM

The GXT Kildrummy reprocessed data provides uplift from the previous surveys (Figure 4.1), however, imaging of the Kildrummy Discovery at reservoir level is still poor with pick and depth conversion uncertainties remaining. Given the increase in signal to noise ratio, it was possible to generate AI volumes to aid with the interpretation. Both Relative and Absolute AI volumes were generated.

The Fugro PSTM+ 3D survey was used to compare the Beaumaris Discovery to relevant wells and hydrocarbon pools to the east and southeast. An AI volume was also generated from the Fugro PSTM+ to aid with the interpretation of Beaumaris and analogues.

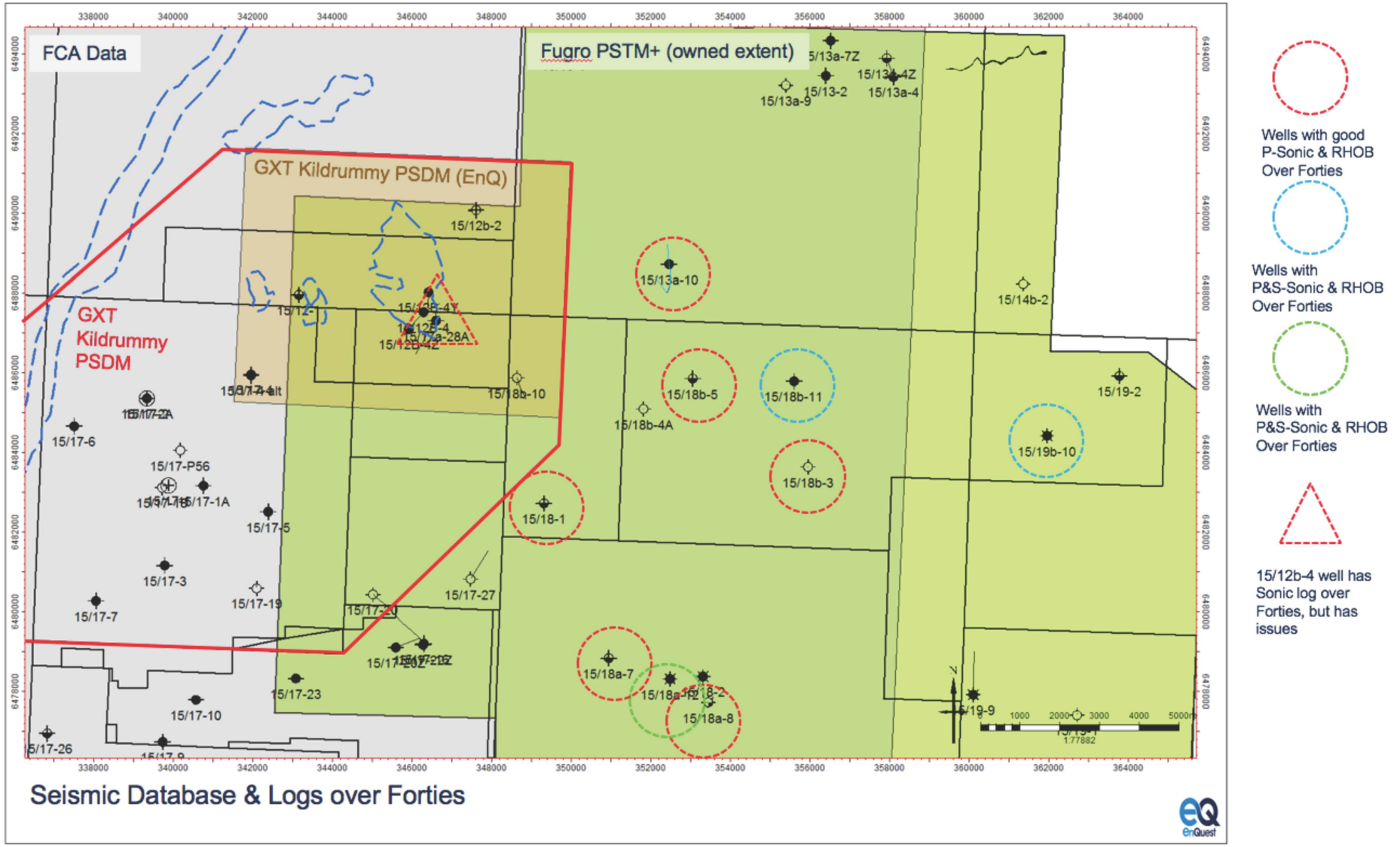


Figure 4-2: Seismic Database

5 Prospectivity Update

5.1 Introduction

Three levels are identified as being prospective in the block: the Upper Jurassic shallow marine sandstones, the Lower Cretaceous Valhall Sandstones and the Tertiary Balmoral, Forties and Dornoch Sands. The deepwater fairways of the Upper Jurassic seen elsewhere in the Outer Moray Firth is absent from the block. Older stratigraphic unit are not considered prospective in the block.

The remaining prospectivity in the block are given in Table 5.1:

Discovery / Prospect Name	Age	Description
Kildrummy Discovery	Late Jurassic	Low relief four-way structural closure
Udny Prospect	Late Jurassic	Low relief four-way structural closure with stratigraphic upside
Beaumaris Discovery	Palaeocene	AVO supported stratigraphic trap

Table 5-1: Discoveries, Prospects and Leads

5.2 Play Components

5.2.1 Upper Jurassic

5.2.1.1 *Reservoir*

The Upper Jurassic shallow marine/deltaic sandstones of the Outer Moray Firth are the proven primary reservoir in the Piper, Scott, Saltire, Tartan, and a number of other smaller fields. These Upper Jurassic shallow marine/deltaic sandstones form a retrogradational package that youngs towards the north as the basin subsided (Figure 5.1). These sandstones mainly belong to J54 and J56 sequences. In the Block 15/12 area this package is significantly younger, belonging to the J64 to J66 sequences. It forms a high net to gross package, up to several 100 ft thick (Figure 5.2 and 5.4), separated from the Piper Sandstone by the lower Kimmeridge Clay, inferring that the Piper delta was flooded by a relative sea level rise and the Kildrummy Sandstone represent a later deltaic progradation.

The Kildrummy shallow marine/deltaic sandstones are equivalent in age to the Main Galley Sandstone to the south (*e.g.* Saltire Field – most northerly occurrence) interpreted as deep-marine turbidites (Figure 5.1). The main Kildrummy Sandstone porosities are in the low 20 porosity units, with permeabilities of 3-10 Darcies.

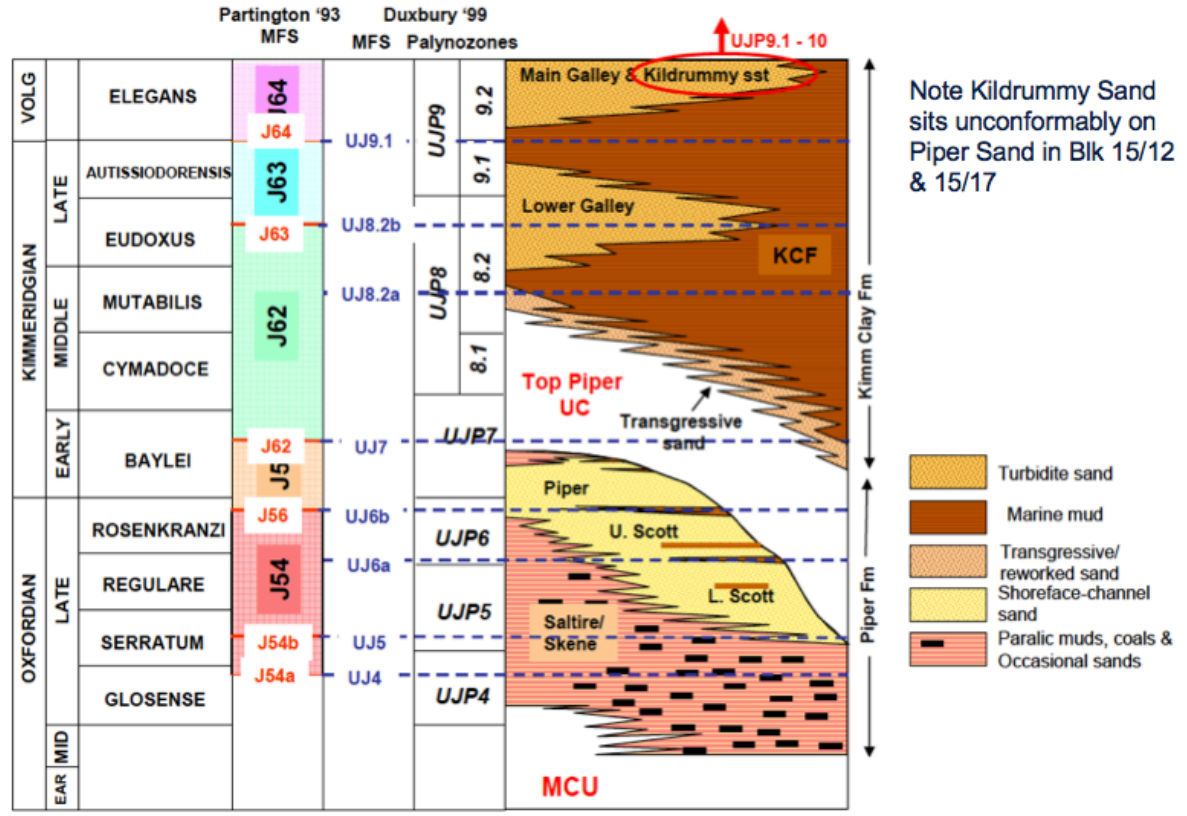


Figure 5-1: Oxfordian to Lower Volgian Stratigraphic Column for Blocks 15/12 and 15/17

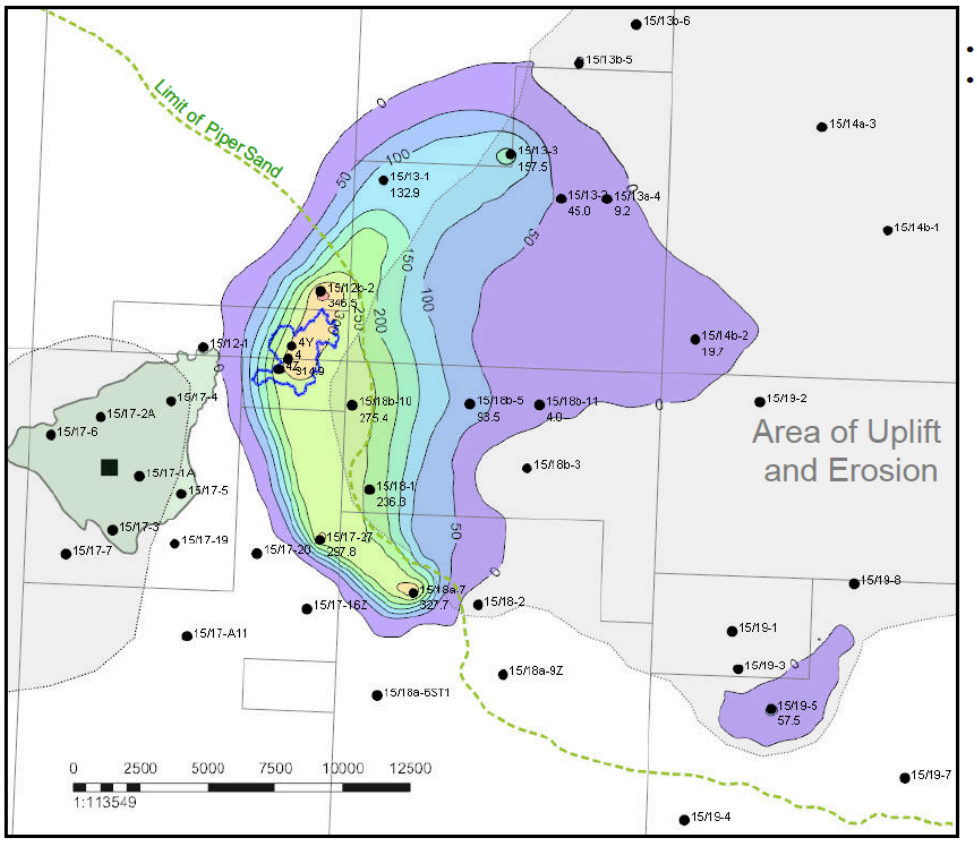


Figure 5-2: Well based isochore map for the Kildrummy Sandstone

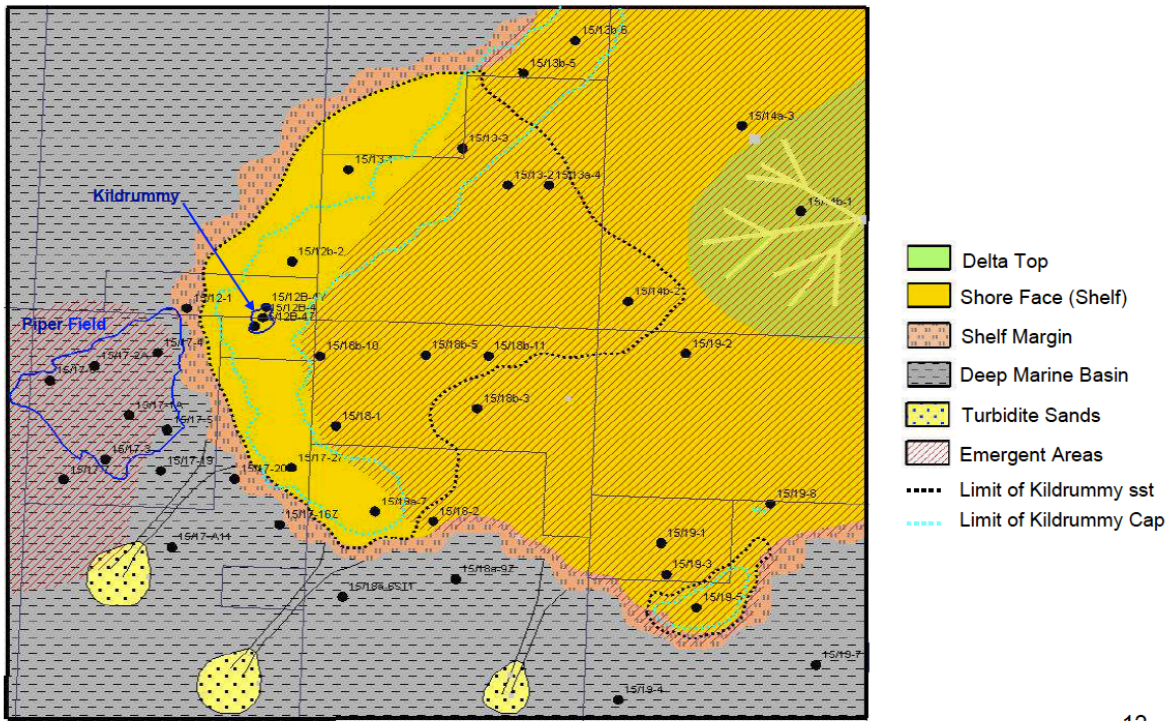


Figure 5-3: Palaeogeographic map for the Kildrummy Sandstone

There is a localised thin (Figure 5.4), but very distinct, Cap Sand that forms a lenticular body in map view (Figure 5.3). This has much worse reservoir quality compared to the main Kildrummy Sandstone with a greater amount of diagenesis and a more mixed mineralogy with the presence of glauconite and pyrite.

5.2.1.2 *Source / Charge*

The Kimmeridge Clay Formation is well established as the primary source rock for the area. In the block it is thin and has not been buried sufficiently to generate hydrocarbons. Migration from the more deeply buried part of Block 15/17 to the south is used to explain the oil charge in Kildrummy, which sits on a spill route from the large Piper Field to the southeast.

5.2.1.3 *Seal*

The Upper Jurassic shallow marine sands are a major play in the area, with seal being provided by the overlying Kimmeridge Clay Formation and Valhall shales. In the case of the Kildrummy Discovery, the KCF thins to 5 ft (15/12b-4) and has maintained its seal integrity despite being cut by small seismic scale faults, with the isolated overlying Valhall Sandstone being water wet. This indicates a high potential to form sealing clay smears along faults. In another well the KCF is absent (15/17a-28) and *ca.* 30 ft of Valhall shales isolates the Kildrummy oil column from the overlying water wet Valhall Sandstone.

A basal seal to the Kildrummy Sandstone is required for the upside of the Udny prospect; a lower KCF package is present in the nearby wells (Figure 5.4), although there is no example of this acting as a seal.

Where the KCF is absent, the Lower Cretaceous Valhall Formation shales and marls provide a seal. In the case where both being absent, the Chalk Group is known to provide a seal. The crest of the nearby Piper Field is sealed by the chalk, with an oil column of the order of 1,200 ft.

Seal risk is very low, as demonstrated by faults in the chalk on crest of the Piper Field, with the field still full to spill.

5.2.1.4 *Trap Style*

The main trap type within the Upper Jurassic shallow marine fairway is structural. These are typically structural highs produced by faulting (*e.g.* Piper Field and Kildrummy Discovery) or downthrown fault seal traps (*e.g.* Saltire and Chanter fields). The nearby Hood Discovery to the northeast is a stratigraphic trap with the shallow marine sands pinching out on to the Fladen Ground Spur. This trap type is unusual within the fairway and appears to be confined to the margins of the fairway.

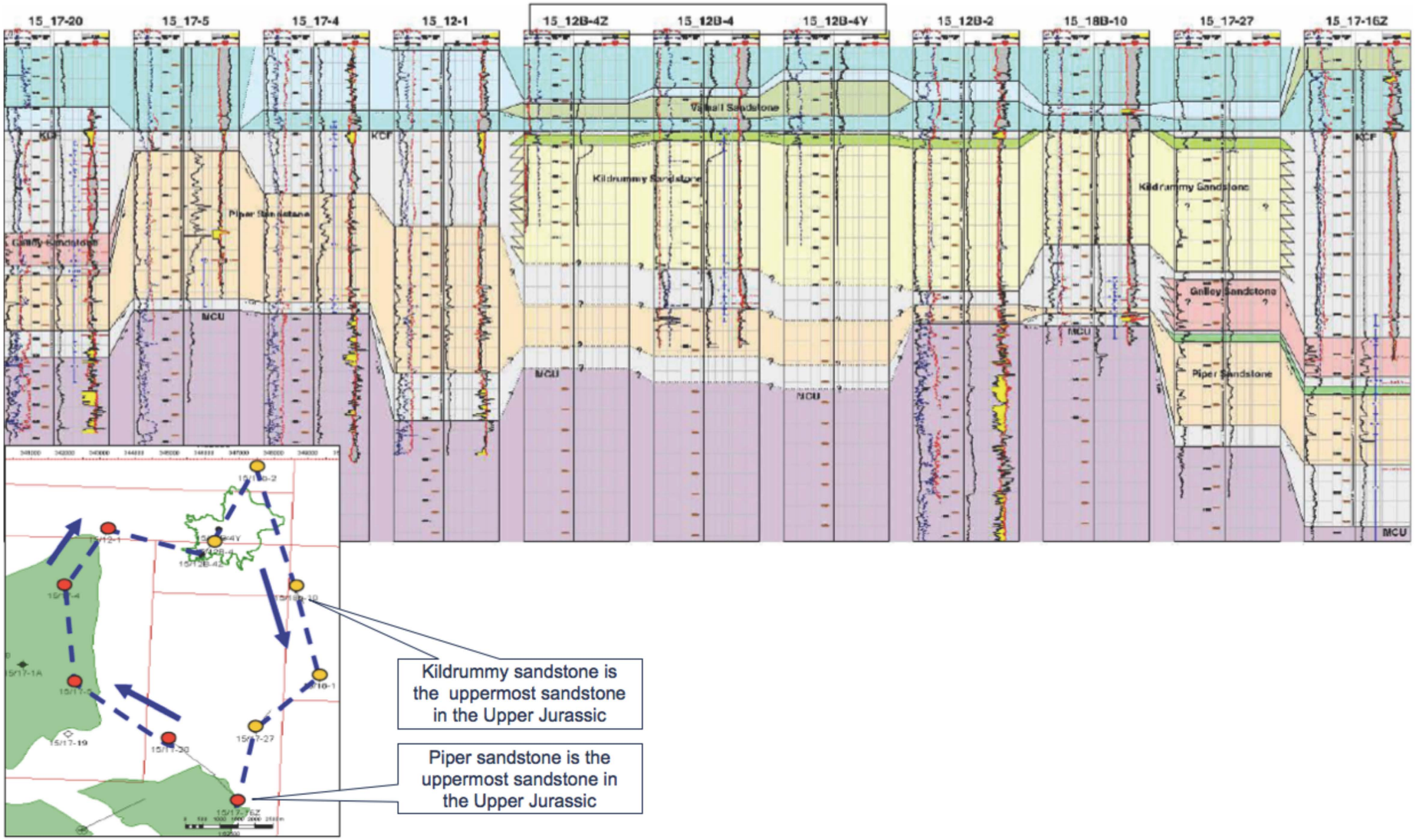


Figure 5-4: Sub-regional well correlation

5.2.2 Lower Cretaceous

5.2.2.1 *Reservoir*

Isolated Valhall Sandstones have been encountered sporadically in Block 15.17. They form an important reservoir in the Saltire Field, where they are interpreted as turbiditic in origin. They have also been encountered above the Kildrummy Discovery, where the depositional environment is possibly turbiditic, though Lower Cretaceous shallow marine sandstones occur further to the NE on to the Fladen Ground Spur.

5.2.2.2 *Source/Charge*

As with the underlying Upper Jurassic, the Valhall Sandstones rely on charge from Kimmeridge Clay Formation source rock. Migration into the Valhall Sandstones is via the more extensive Upper Jurassic sandstones. In the case of Kildrummy these sandstones are water wet, yet in the well with the thinnest seal, they are separated by only 5 ft of Kimmeridge Clay Formation (15/12b-4), which is cut by small faults imaged on seismic.

5.2.2.3 *Seal*

Seal is provided by the thick overlying Valhall shales and marls.

5.2.2.4 *Trap type*

Given the isolated nature of the Valhall Sandstones, they have the potential to form stratigraphic traps, although because of the faulted nature of the area they are more likely to be in combined structural-stratigraphic traps or structural traps. The latter is likely to exist at Kildrummy, but has not been charged.

5.2.3 Tertiary

5.2.3.1 *Reservoir*

The Outer Moray Firth contains a thick package of Tertiary sediments with numerous reservoir quality sands. Typically, hydrocarbons have progressively moved higher in the package as they migrate westwardly. In the block, the Balmoral, Forties and Dornoch sands are of potential interest based on offset wells.

The Balmoral Sands are deep marine turbidites with a sheet like distribution. In contrast the younger Forties Sands form a more channelised system which runs roughly from WNW to ESE. Typically, thick sands units fill the incised channels interbedded with thinner muds. The uppermost sands within the channel fill may be thinner and less continuous, with crevasse splay sands deposited on the margins of the channel. In Figure 5.6 a well correlation panel shows the lateral variation in sand units. In the figure the uppermost Forties Sands, labelled Reservoir sands (reservoir for Beaumaris), has its sands largely restricted to a single well.

In Figure 5.5 a seismic line shows the Dornoch delta clinoforms overlying the Forties (labelled Beaumaris reservoir) and deeper Balmoral Sands. Shoreface sands at the top of the clinoforms package form potential reservoir sands.

5.2.3.2 *Source/Charge*

The Kimmeridge Clay Formation is well established as the primary source rock for the area. Charge of the Tertiary is likely to be dominated by intra-Tertiary migration from the SE, with up to tens of

kilometres of migration. However, some local charge from the southern part of Block 15/17 cannot be ruled out, with lateral migration via the Upper Jurassic sandstone before vertical migration on faults.

In the case of the Beaumaris Discovery, it is likely that migration occurred along a Forties turbiditic channel sand, on which the down-dip Maria Discovery is located.

5.2.3.3 *Seal*

Lista Formation muds provide top seal for the Balmoral Sands, however, these are thinned in places by incision of Forties turbiditic channel sands.

The immediate top seal to the Forties is the Sele Formation mudstones, though these are relatively thin within the block, as shown on the well correlation in Figure 5.6 (magenta correlation unit). Within the block the Dornoch delta has prograded over these thin Sele muds. The prodelta muds contain turbiditic sands, which could potentially act as thief zones.

The Dornoch deltaic sands are sealed by muds of the overlying high-stand muds.

5.2.3.4 *Trap type*

Trap types within the Forties are typically 4-way dip closures, with or without additional stratigraphic upside. Where the sands are thinner and more interbedded with muds, then stratigraphic trapping mechanisms can dominate.

Trapping with the Dornoch and Balmoral is again typically structural, though stratigraphic components may also be present.

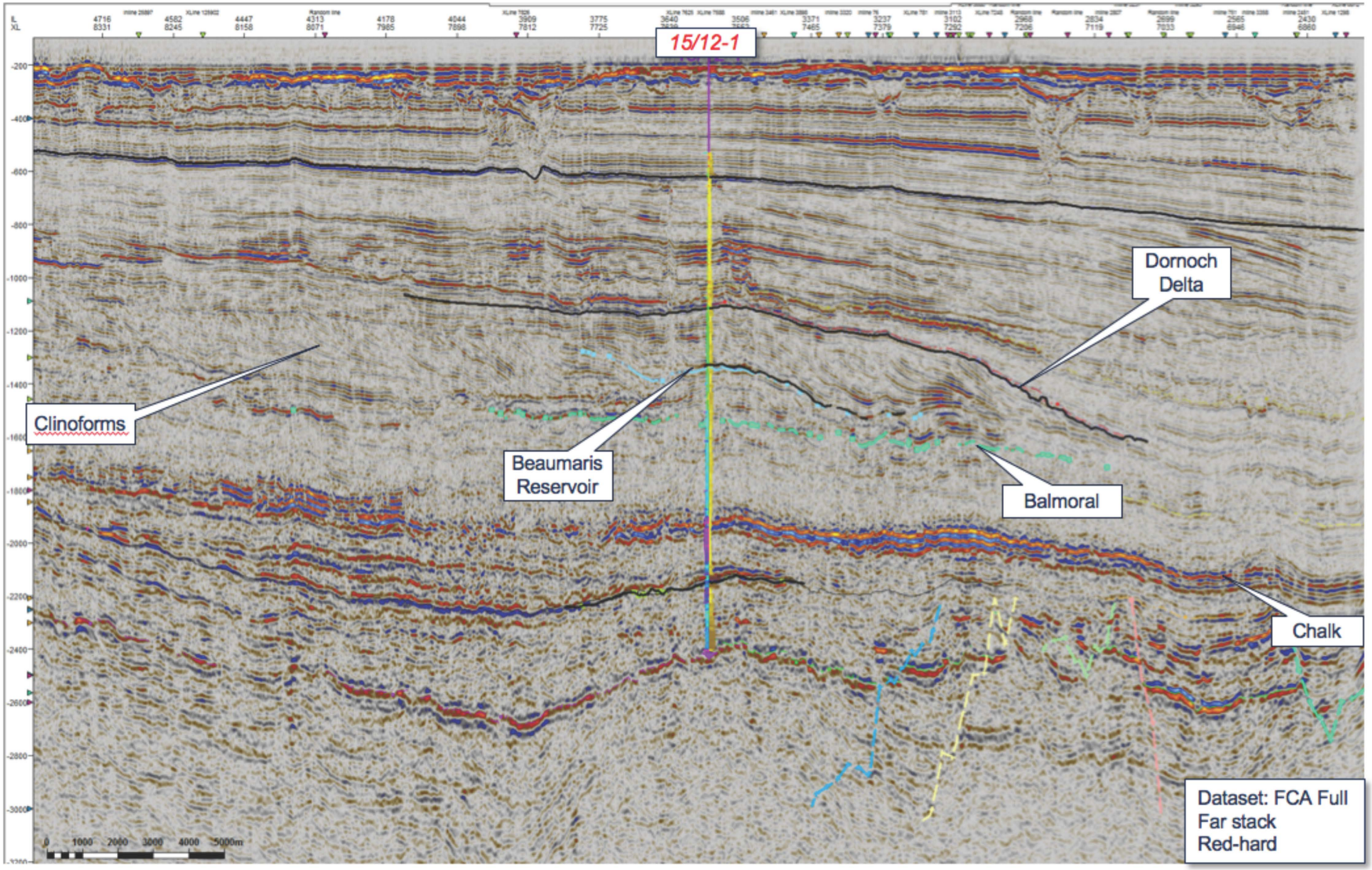


Figure 5-5: Sub-regional seismic line through the Beaumaris Discovery

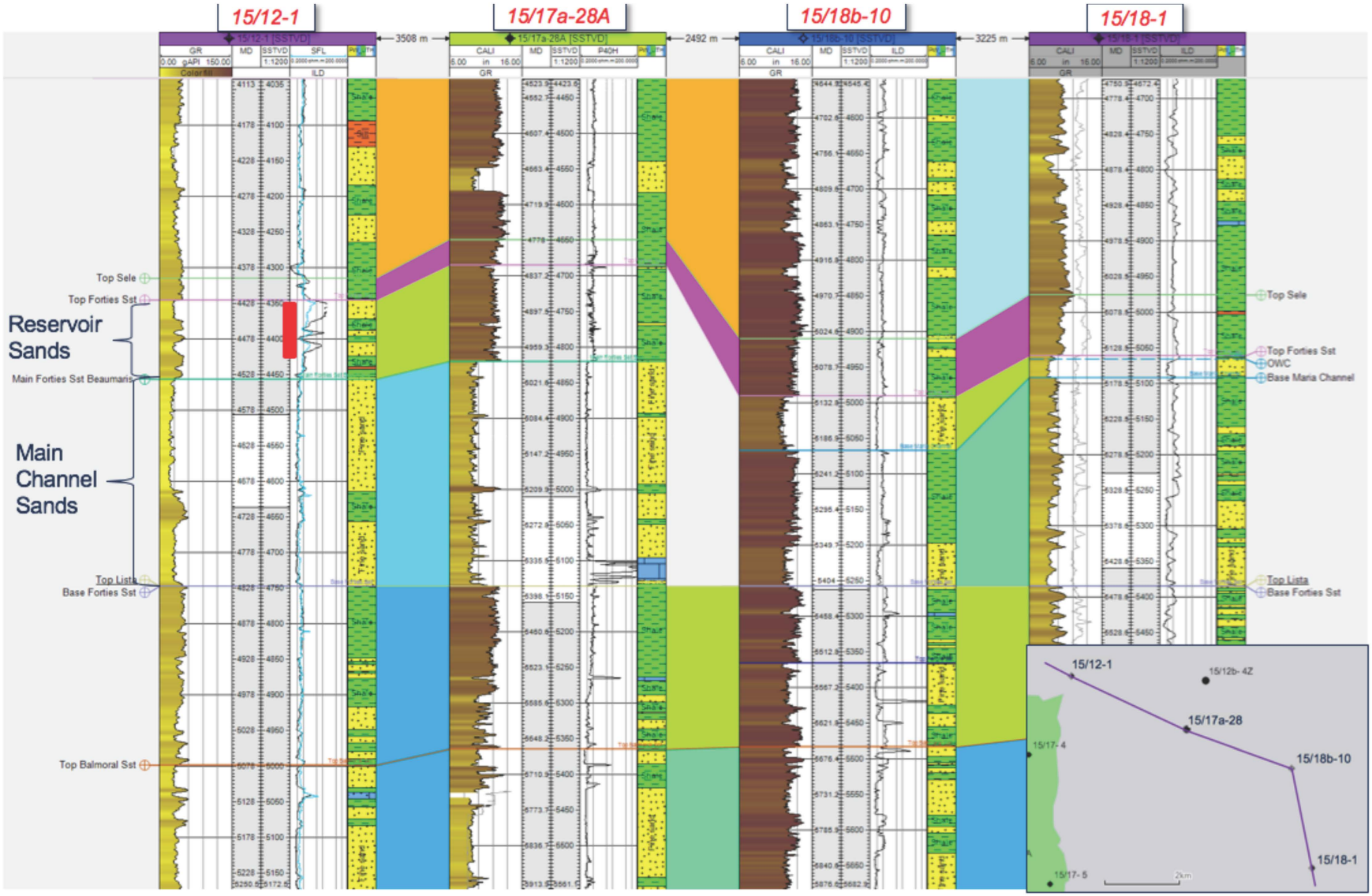


Figure 5-6: Well correlation through the Beaumaris Discovery

5.3 Prospects and Leads

The only prospect or lead identified in the block is the Udny prospect.

5.3.1 Udny Prospect

The Udny prospect is four-way dip closure at Kildrummy Sandstone level, with stratigraphic trapping along the western Kildrummy Sandstone pinchout margin (Figure 5.8). It is located adjacent to the spill from the Piper Field, though in a younger shallow marine/deltaic sandstone (Kildrummy Sandstone). The two sandstones are known to be in pressure communication. Udny most likely shares the same OWC as the Piper Field (*i.e.* -8,510ft). This pressure communication does put an element of doubt on the likelihood of the stratigraphic trapping.

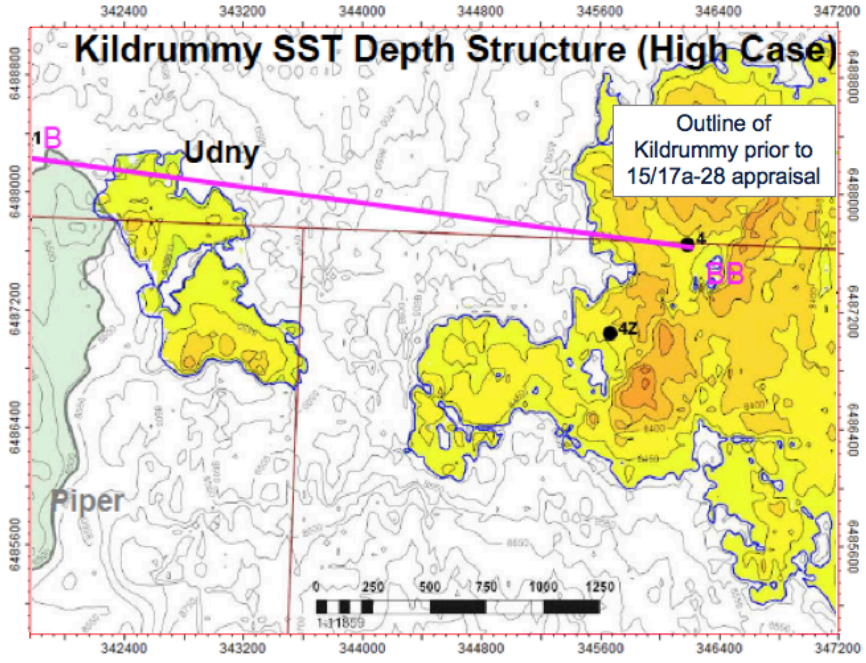


Figure 5-1-7: Kildrummy Sandstone depth structure map with Udny prospect. (Corresponds to *ca.* Percentile 23)

Udny was evaluated as part of the Kildrummy seismic interpretation (Section 6.1.1) prior to the 15/17a-28 appraisal well. Unlike at Kildrummy, a thicker Kimmeridge Clay Formation is present, and it can be mapped with more certainty. However, this still requires the top reservoir pick to be tied to the Kildrummy wells through an area of poor seismic imaging.

To calculate volumes, fifteen separate deterministic cases were run and fitted to a lognormal distribution. These were based on selected cases from the Kildrummy pre-15/17-28 appraisal well evaluation, using two different picks, different isochores of the Cap Sand, different depth conversions, and different potential OWCs. Given the size of Udny, this evaluation was not revised following the 15/17-28A and 28z well results.

Udny	Units	P90	P50	P10
STOIIP	MMstb	0.8	7.6	75.7
Prospective Resource	MMstb	0.1	1.5	29.5

Table 5-2: Udny volumetric estimates

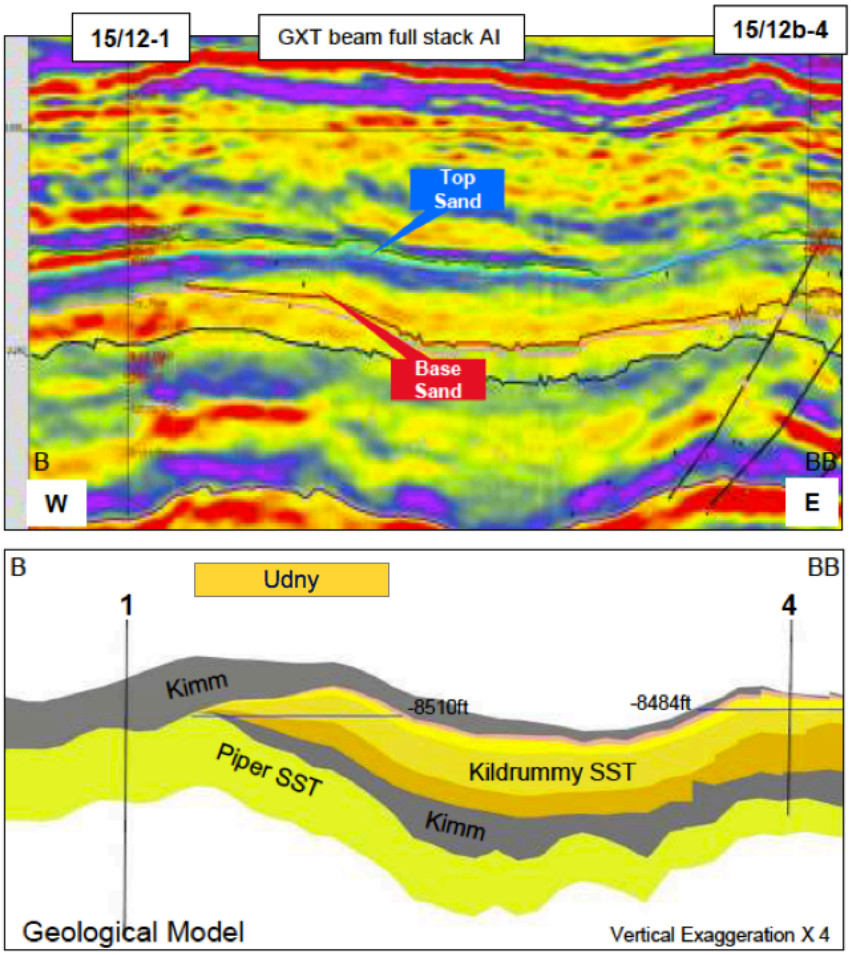


Figure 5-8: Udny prospect seismic line and geoseismic section. For line location see Figure 5.7.

6 Discoveries

6.1 Kildrummy

The Kildrummy Discovery is a low relief four-way dip closure defined by five well penetrations, with poor seismic quality. It is reservoired in Upper Jurassic fluvio-shallow marine sandstone (informally known as the Kildrummy Sandstone or Sand), which is the equivalent in age to the Main Galley deep-marine turbiditic sands to the south. Reservoir quality is excellent, with the exception of a thin more cemented sand sheet at the top, which acts as a "waste zone" that is unlikely to contribute to reserves.

The low relief accumulation is underlain by a thick aquifer, requiring development with a horizontal well/s positioned with maximum stand-off to the aquifer and reduced drawdown during production. The thickest oil column penetrated in the good quality main Kildrummy Sandstone is 65 ft (15/17-28A).

Localised poor seismic quality at Kildrummy caused by the geophysical characteristics of the strata has resulted in uncertainties in defining the low relief structure. Following discovery, it was mapped

as “donut-shaped” on the new FCA 2002 survey with the discovery well located in the central low. This structural interpretation was proven to be incorrect with the drilling of the 15/12b-4z and 4y sidetracks, following which the Kildrummy development was cancelled. The later drilling of the 15/18b-10 well provided a new well tie to the east, indicating the possibility of a larger Kildrummy structure. Despite reprocessing of the seismic very large uncertainties remained, but with a clear potential upside.

To reduce the uncertainty, an appraisal well and two sidetracks were planned to help define the structure. These would address both pick and depth conversion uncertainty. Well penetrations where targeted at undrilled areas where it was possible to make a continuous seismic pick and would thus maximise proven STOIIP. Well 15/17a-28A and sidetrack 15/17a-28z were drilled, both with disappointing results as top reservoir came in deep, and as a consequence the second sidetrack was cancelled.

6.1.1 Geophysical Interpretation

The Kildrummy structure was interpreted on the GXT Kildrummy PSDM and the associated AI volumes (Figure 6.1). The AI volumes allowed better picking of the top reservoir sand; previously the Kildrummy structure was interpreted on the BCU.

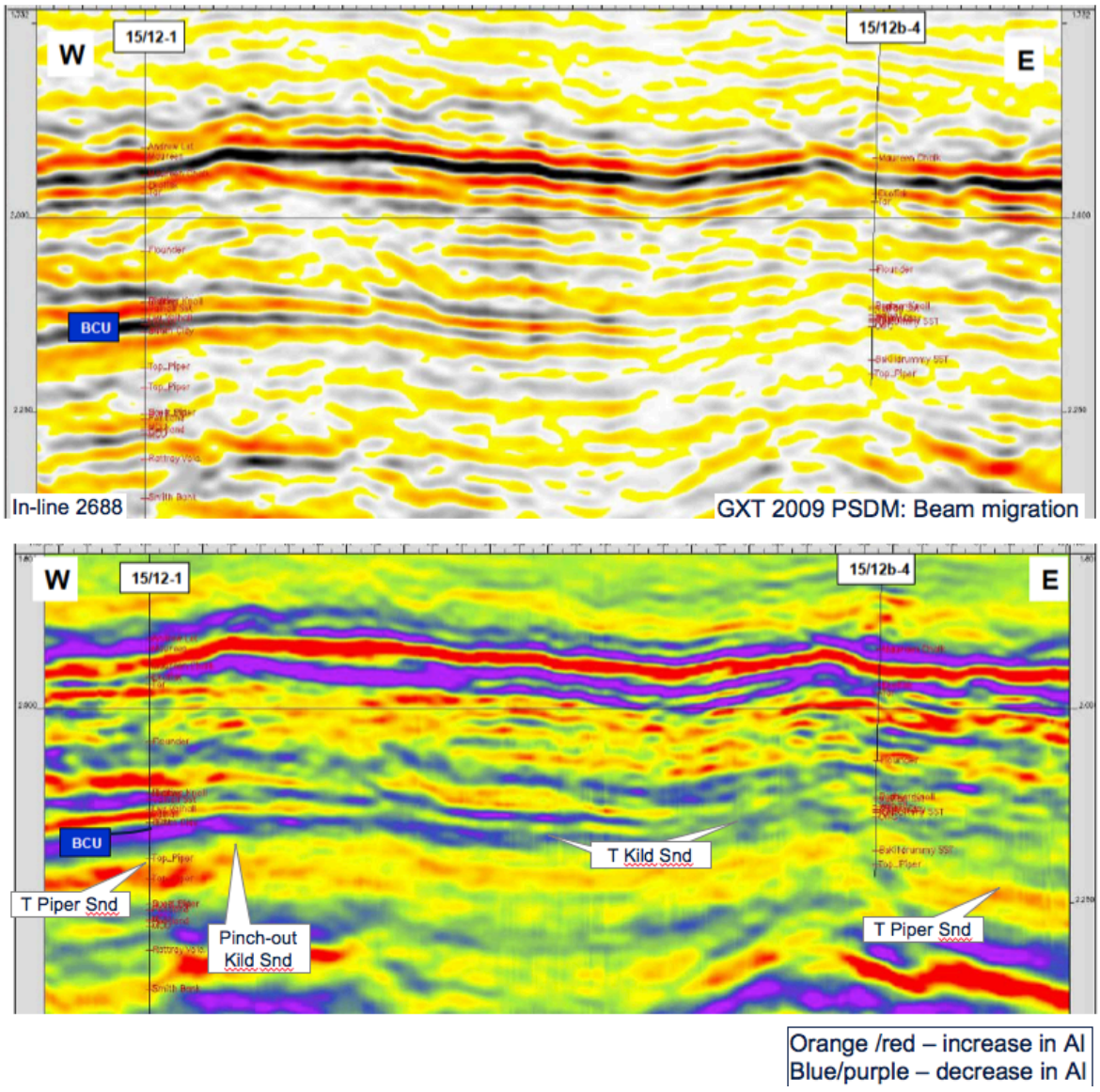


Figure 6-1: Full stack in-line and AI equivalent line though Kildrummy

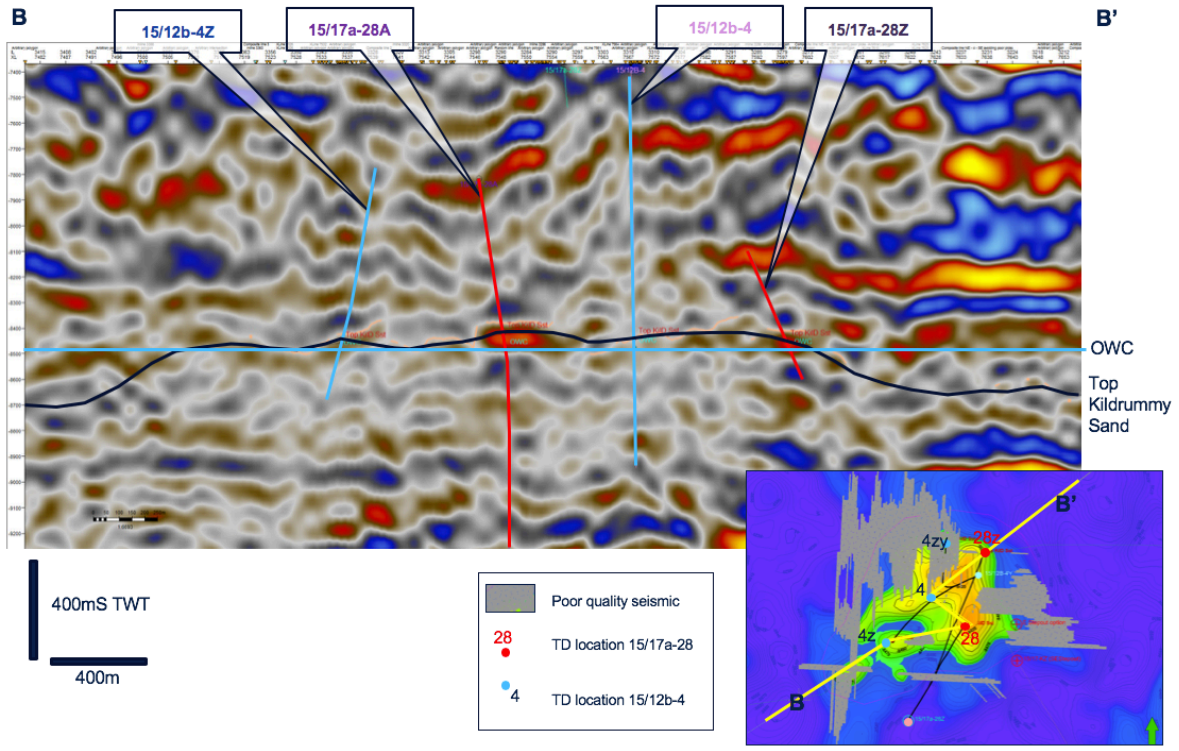


Figure 6-2: Seismic traverse through Kildrummy showing 4 well penetrations

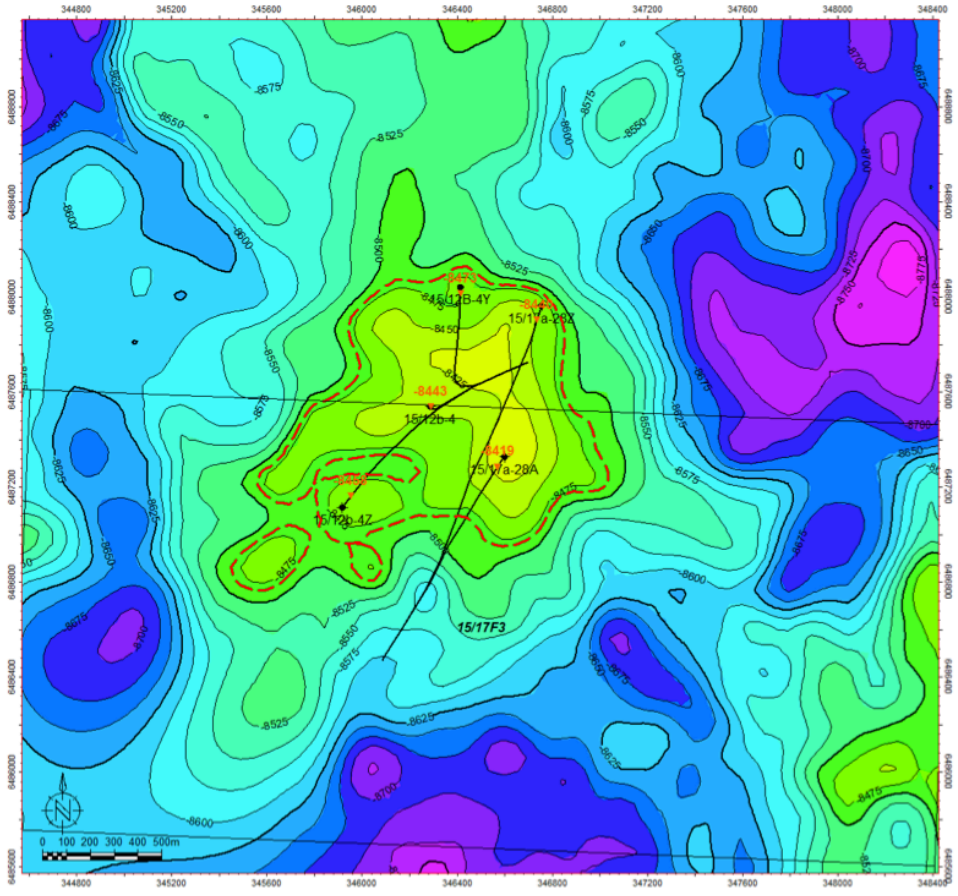


Figure 6-3: Top Kildrummy reservoir depth structure map

Synthetic seismograms were produced for the Kildrummy wells 15/12b-4, 4z and 4y, and the following surrounding wells: 15/12-1, 15/12b-2, 15/17-4 and 15/18b-10. None of the ties are particularly good; the best of which is well 15/12-1. Key seismic events were picked, the most important of which are top Chalk, BCU, base Kildrummy Sandstone, top Piper Sandstone, and high and low cases for the top Kildrummy Sandstone.

There are five wells on the Kildrummy accumulation, in an area which is a slightly over 1 km^2. The seismic quality is poor and it is difficult to interpret away from the wells with much certainty (Figure 6.2). The structure is low-relief and very sensitive to pick and depth conversion uncertainties, however, this has been largely overcome with the five well penetrations (Figure 6.3).

Prior to drilling the 15/17-28A and 28z wells, high and low case top Kildrummy Sandstone picks were made primarily on the GXT 2009 PSDM. These were then depth converted using five different depth conversion methods to generate different cases for the volumetrics. Depth conversion methods used were:

- V_0+*K*
- V_{av} (from GXT 2009 PSDM)
- V_0+*K* to top Chalk, and V_{int} from top Chalk to deeper horizons
- V_{av} to top Chalk, and V_{int} from top Chalk to deeper horizons
- Time-depth function (T-Z)

The V_{av} depth conversion was the favoured method and following the drilling of the 15/17-28 wells this method was used for the final map (Figure 6.3).

6.1.2 Petrophysical Evaluation

Reservoir quality in the main Kildrummy Sandstone is extremely high, similar to the nearby Piper Sandstone in the Piper Field, with the exception of the Cap Sand which has a much lower permeability. In the main Kildrummy Sandstone, calculation of petrophysical averages show a virtually 100% net system with porosities in the low 20 porosity units, and permeabilities in the range 3-10 Darcies (Figures 6.4, 6.5 and 6.7). The overlying Cap Sand has a net to gross of 85-100%, but average porosities in the range of 12-13% and permeabilities in the range 10-75 mD.

Above the transition zone, excellent oil saturations occur in the main Kildrummy Sandstone, however, oil saturations for the Cap Sand are calculated from wireline as extremely low (Figures 6.4 and 6.7). However, the mixed mineralogy of the Cap Sand is interpreted to be suppressing the resistivity.

The Kildrummy OWC varies from -8,488 ft in the southwest to -8,475 in the east (Figures 6.4 and 6.7) and overall there appears to be a sloping OWC deepening towards the Piper Field. The FWL is calculated at -8,489 ft. Given the rock quality, and small displacement on any of the faults, this is not interpreted as being due to fault seal. One possible interpretation is that this slight tilting is caused by aquifer flow related to Piper Field production.

6.1.3 Fluid Properties

Samples of oil were obtained from the 15/12b-4 well using an MDT tool. The oil obtained was a light sweet crude, with the PVT analysis indicating a specific gravity of 33.7° API, a GOR of 321-397, and a

bubble point pressure of 1320 psia. Reservoir pressure was measured by MDT at -8,489 ft as 3,657 psia. The FVF was calculated as 1.27. The crude has a wax content of 4.97%, and contains asphaltenes (*ca.* 0.6% wt heptane insoluble).

6.1.4 Volumetrics

A single deterministic case was run for the in-place volumes (Table 6-1).

Kildrummy	FWL feet TVDSS	N:G fr	Phi fr	So fr	Bo rb/stb	STOIIP MMstb	Contingent Resource MMstb
Best Case	-8,484	1.0	0.23	0.9	1.27	9.7	3.9

Table 6-1: Kildrummy volumetric estimates

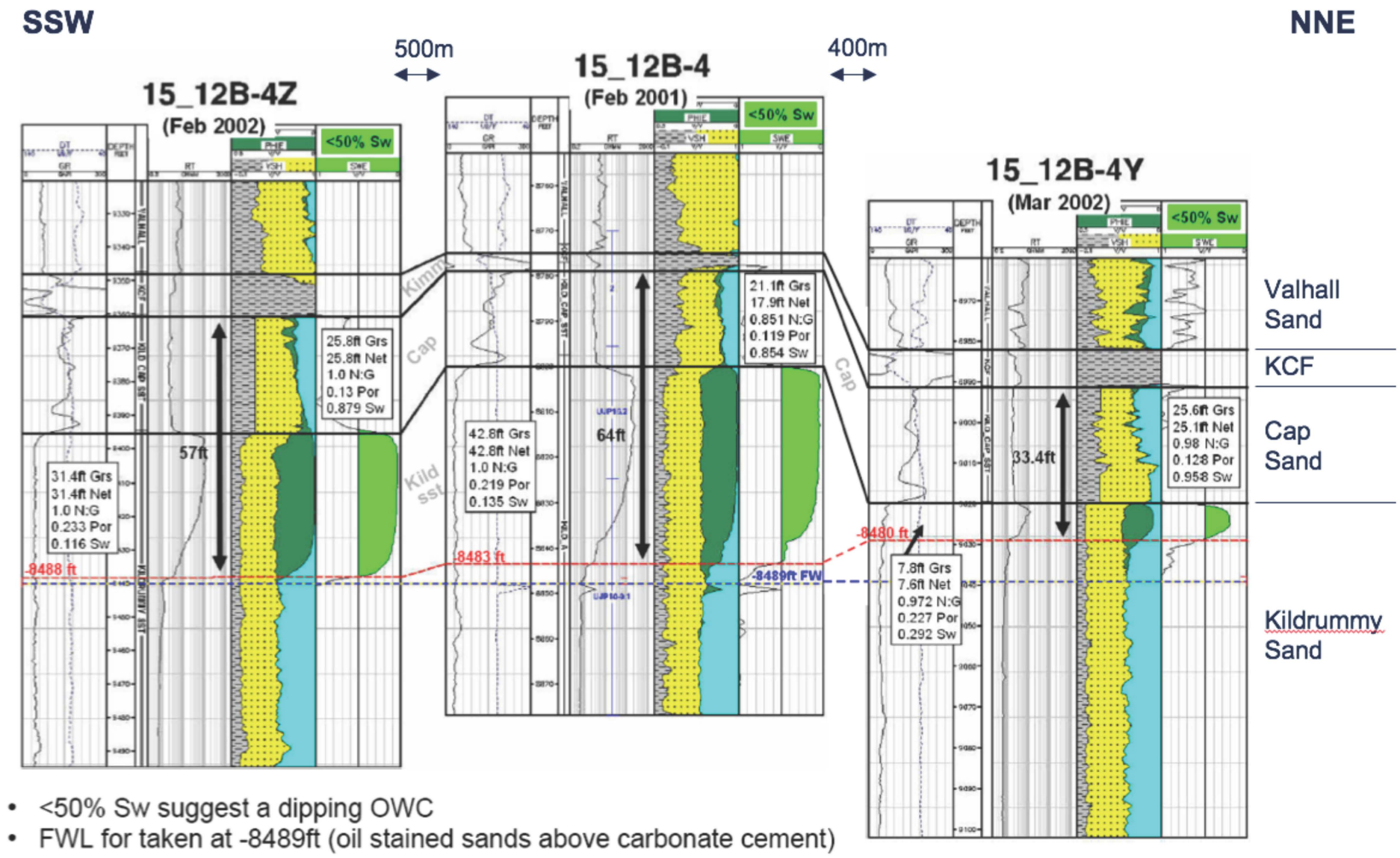
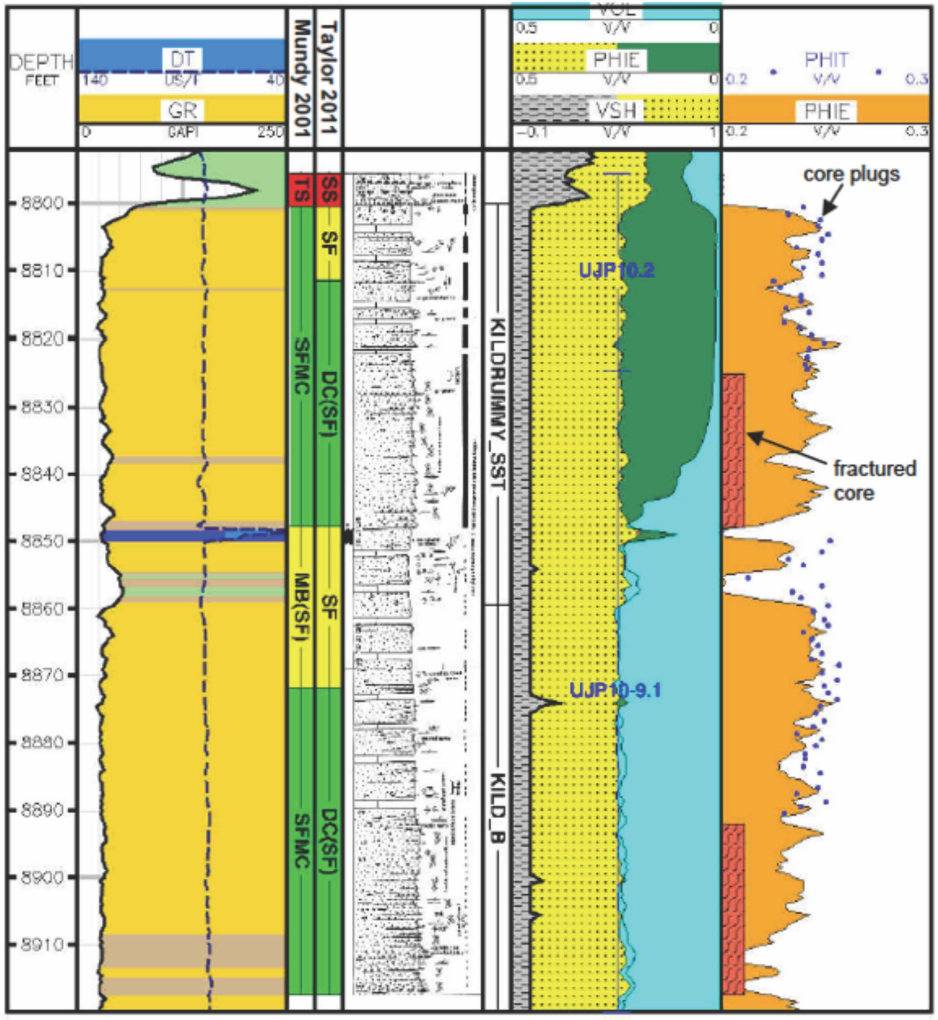
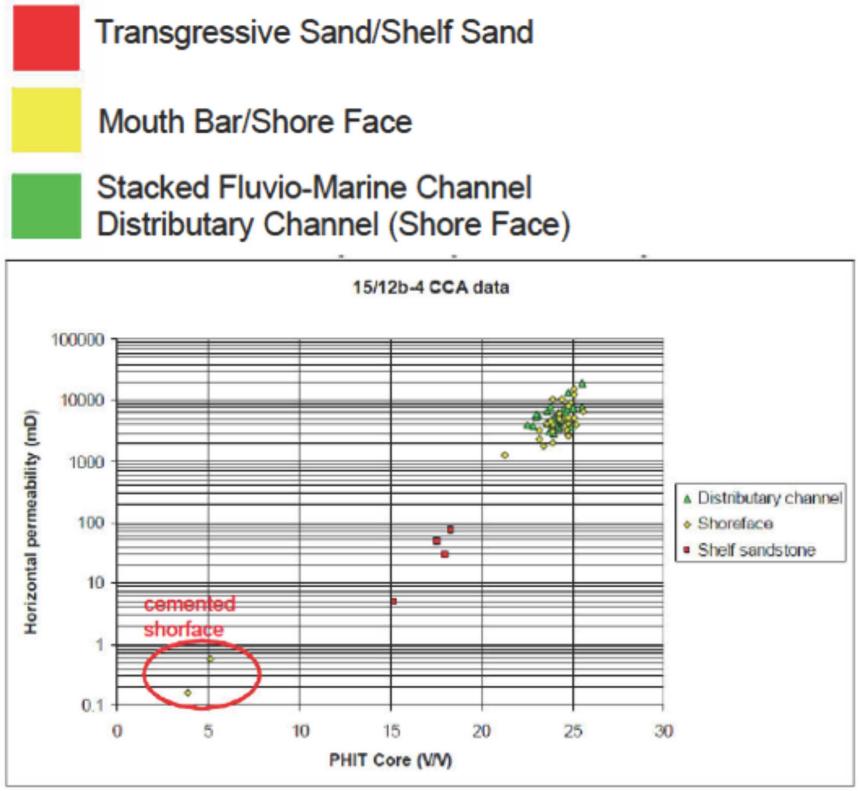


Figure 6-4: CPIs for wells 15/12b-4, 4z and 4y





- Taylor 2011 core interpretation broadly similar to Mundy 2001
- Shore Face and Channel facies can't be distinguished from by porosity and permeability – both show similar values

Figure 6-5: Core log plotted against wireline, with CPI and core porosities for well 15/12b-4. Permeability-porosity cross plot colour coded by depositional facies.

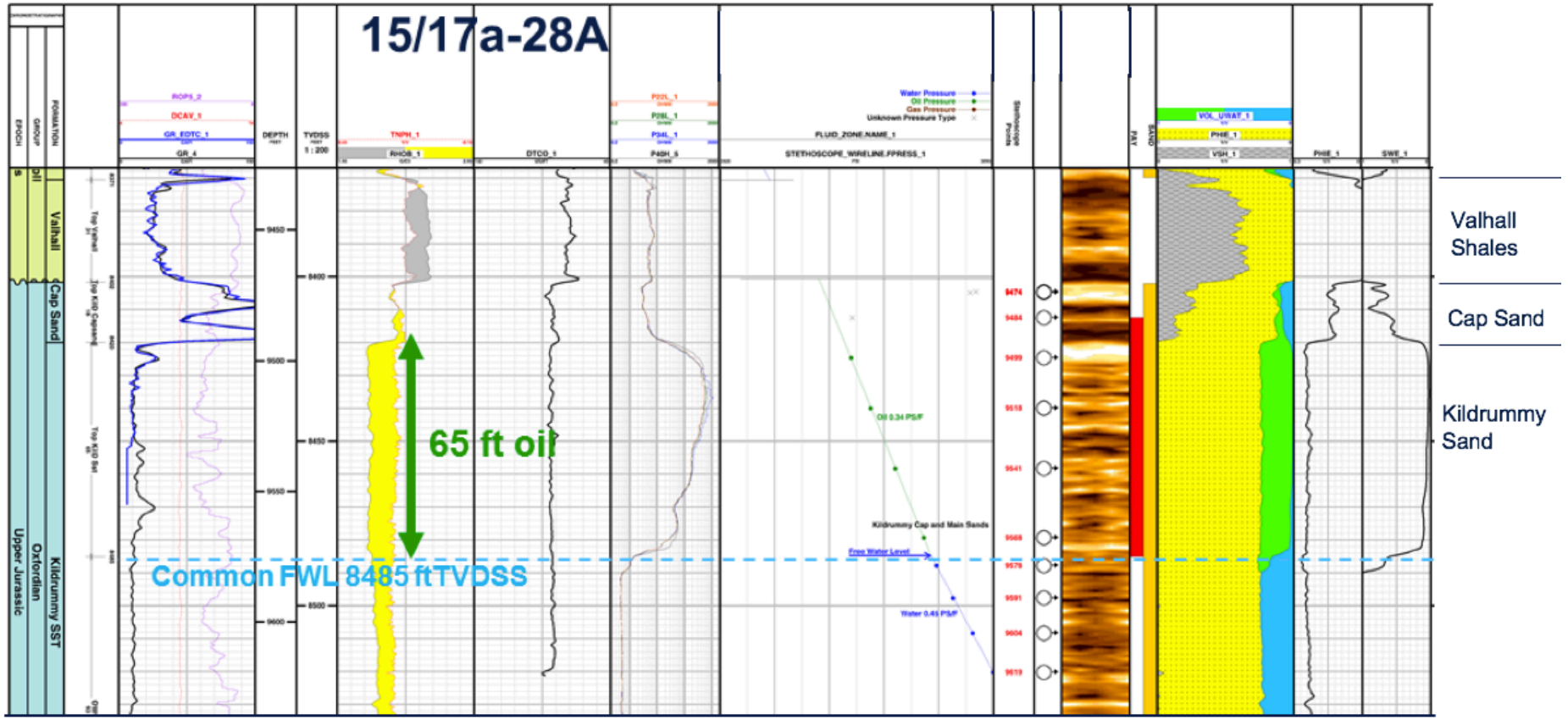


Figure 6-6: CPI for well 15/17-28A

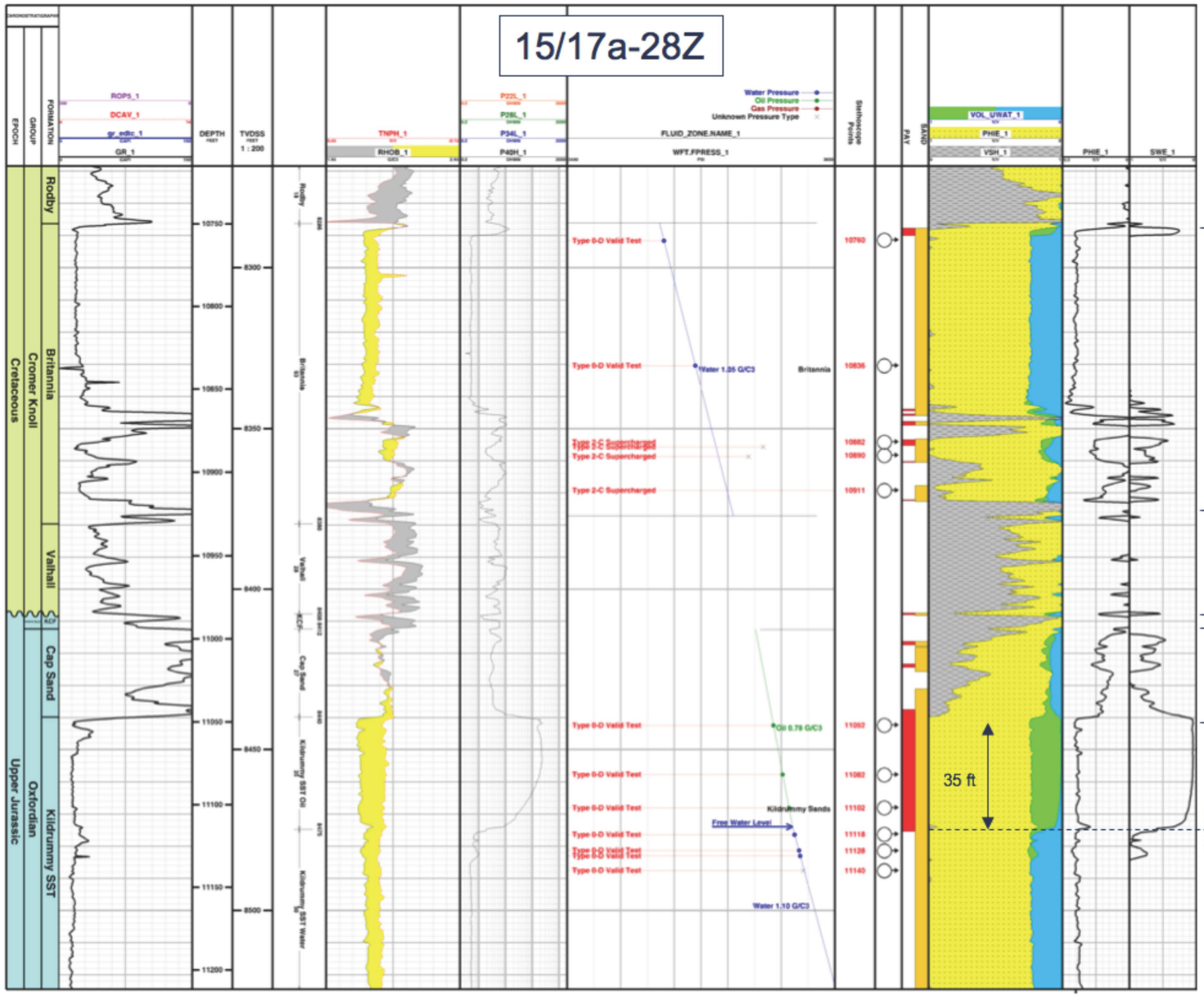


Figure 6-7: CPI for well 15/17a-28z

6.2 Beaumaris

Beaumaris is a Forties Sand reservoired heavy oil accumulation discovered in 1973 by the 15/12-1 well, with an oil-down-to. It is an AVO supported stratigraphic trap, with an oil column of the order of 50 ft. The Beaumaris reservoir is a localised sand body at the top of a multi-fill Forties turbiditic channel (Figure 5.6), with the underlying main Forties sand being water wet.

The uncertainties at Beaumaris are fluid contact, the extent of reservoir development, and the productivity.

6.2.1 Geophysical Interpretation

Beaumaris was interpreted on the FCA 2008, GXT Kildrummy PSDM and the Fugro PSTM+ seismic volumes. The GXT Kildrummy PSDM survey only covered the eastern half of Beaumaris, whereas the Fugro PSTM+ dataset allowed Beaumaris to be compared to Tertiary hydrocarbon accumulations to the east and southeast. AI volumes of the GXT Kildrummy PSDM and the Fugro PSTM+ were also utilised in the interpretation.

Key horizons were interpreted, the most important of which are: top Dornoch, top Beaumaris reservoir, top main Forties, and top Balmoral. The top Beaumaris reservoir is a relatively local pick related to the development of the uppermost Forties sand in the channel.

The Beaumaris accumulation corresponds to an amplitude bright on seismic and displays a Class 2 AVO response (Section 7). It sits within a turbiditic channel fill, which has a mounded topography due to differential compaction. Locally this forms a plunging nose (Figure 6.8) with the Beaumaris reservoir pinching out updip on to the nose. A cross channel seismic line through Beaumaris is shown in Figure 6.9, and a channel parallel seismic line in Figure 6.10.

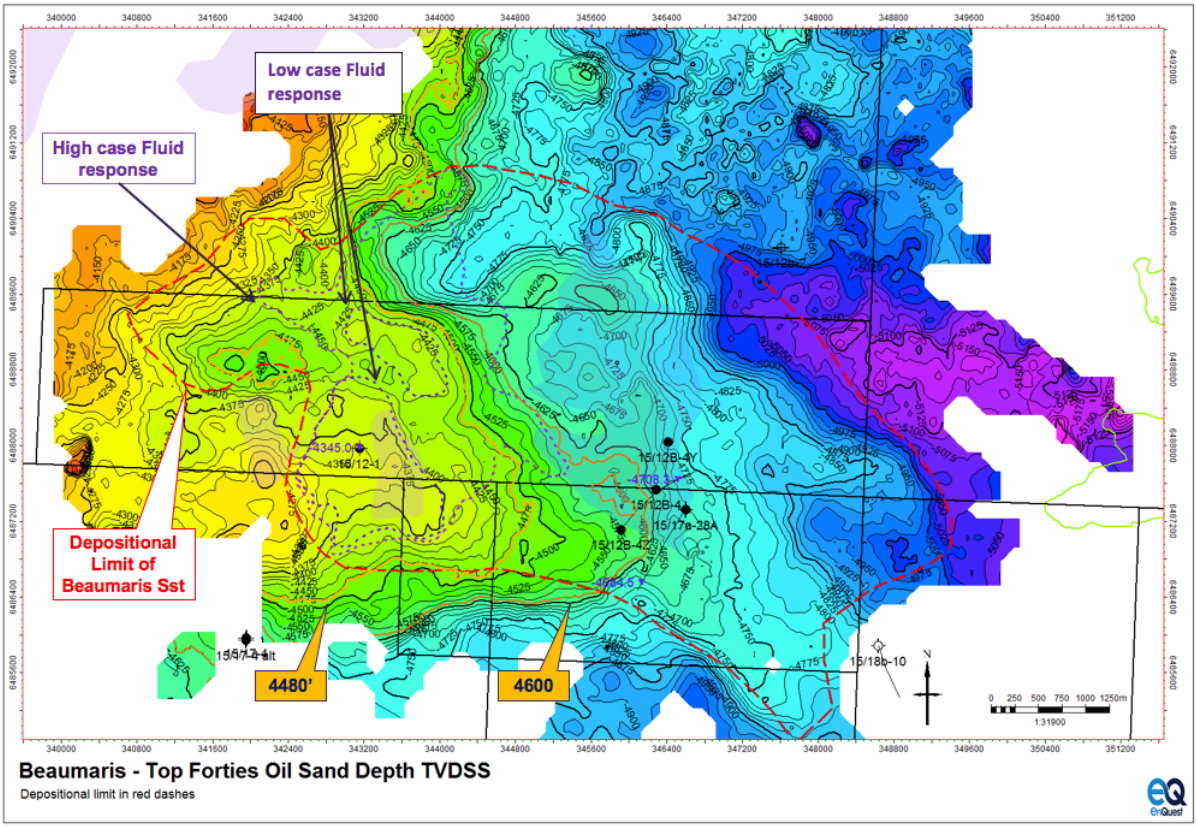


Figure 6-8: Top Beaumaris Forties depth map with polygons used for volumetrics

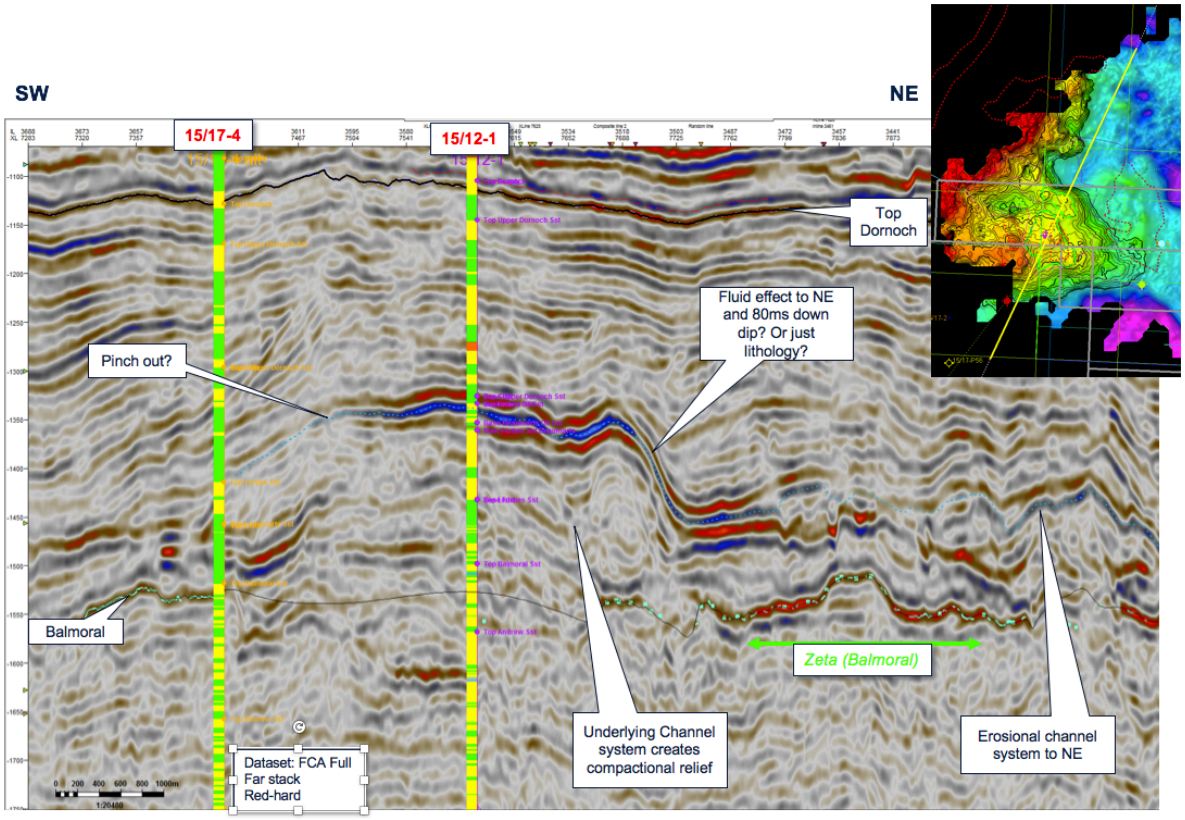


Figure 6-9: Seismic line through Beaumaris Discovery running across the channel axis

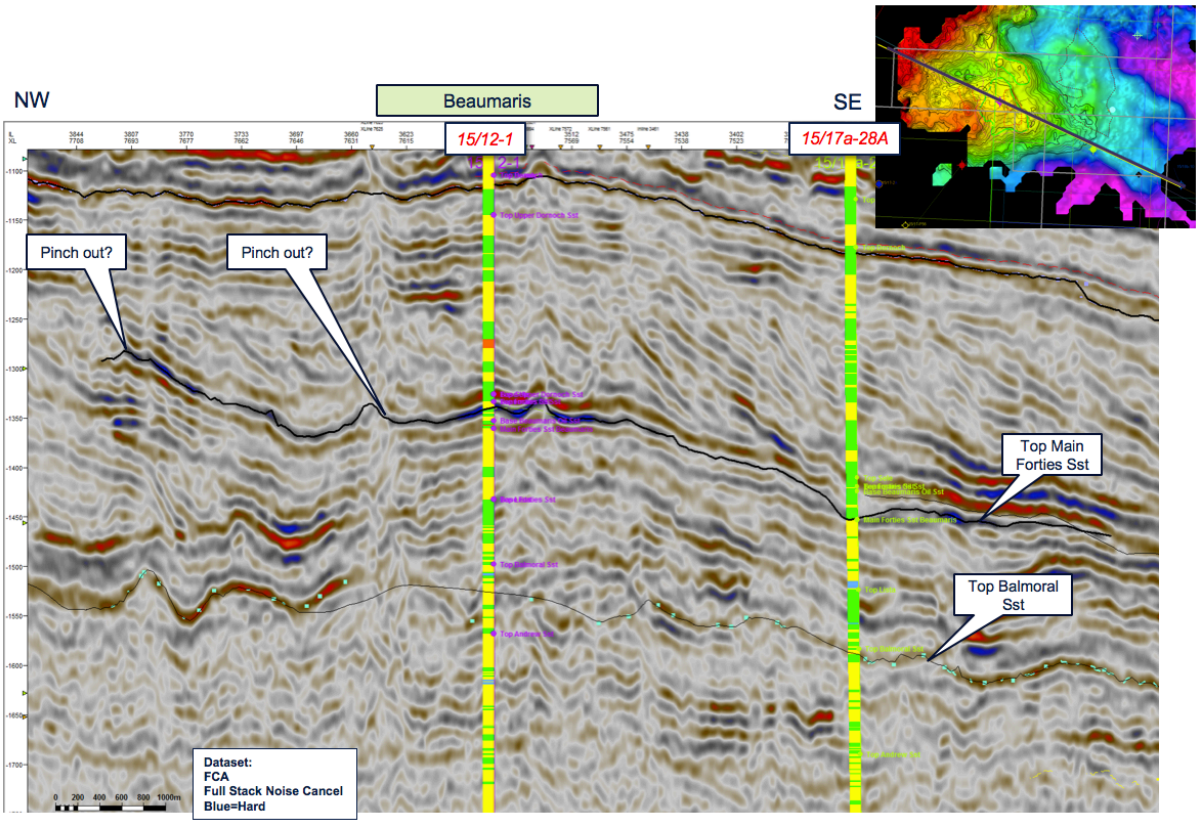


Figure 6-10: Seismic line through Beaumaris Discovery parallel to the channel axis

The Beaumaris reservoir package has been mapped from seismic (Figure 6. 11) and this is compared with a well based isochore (Figure 6.12). The Beaumaris reservoir package extends as far down-channel as Kildrummy, where it is low net to gross, and also appears to pinchout on the margins of the channel. Due to reservoir thinning, it is difficult to distinguish if amplitude changes are caused by fluid or lithology.

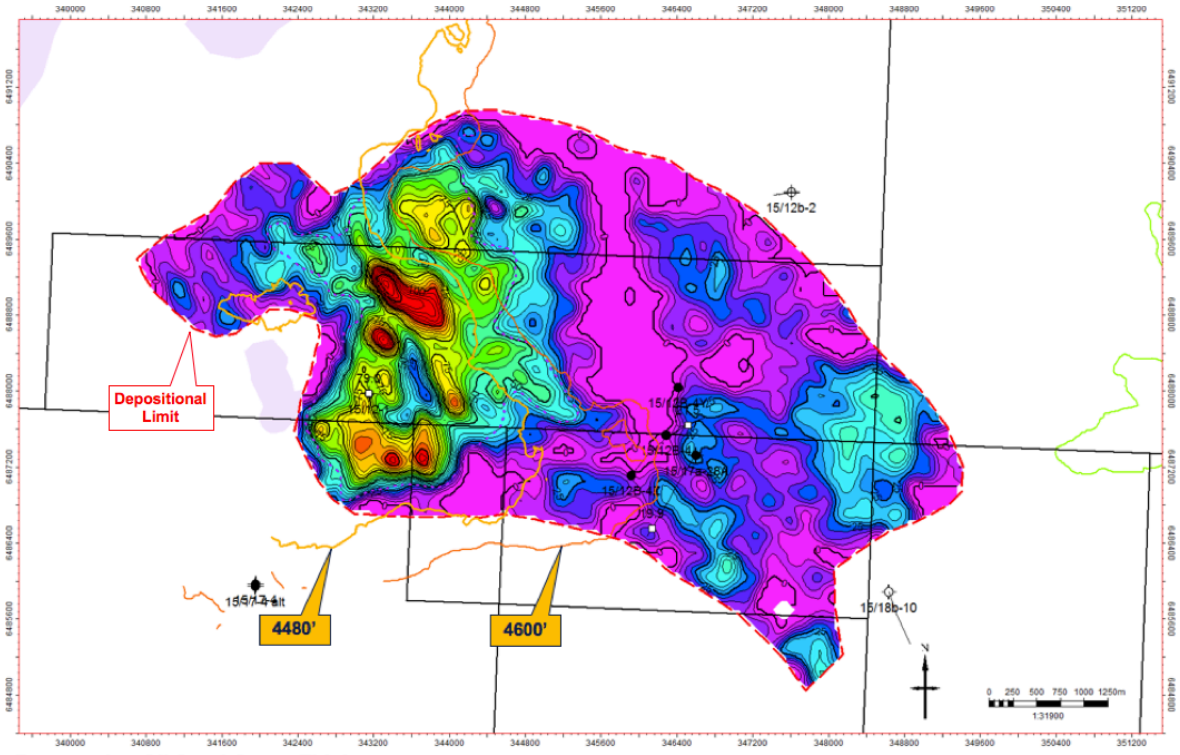


Figure 6-11: Beaumaris reservoir sand gross thickness mapped from seismic

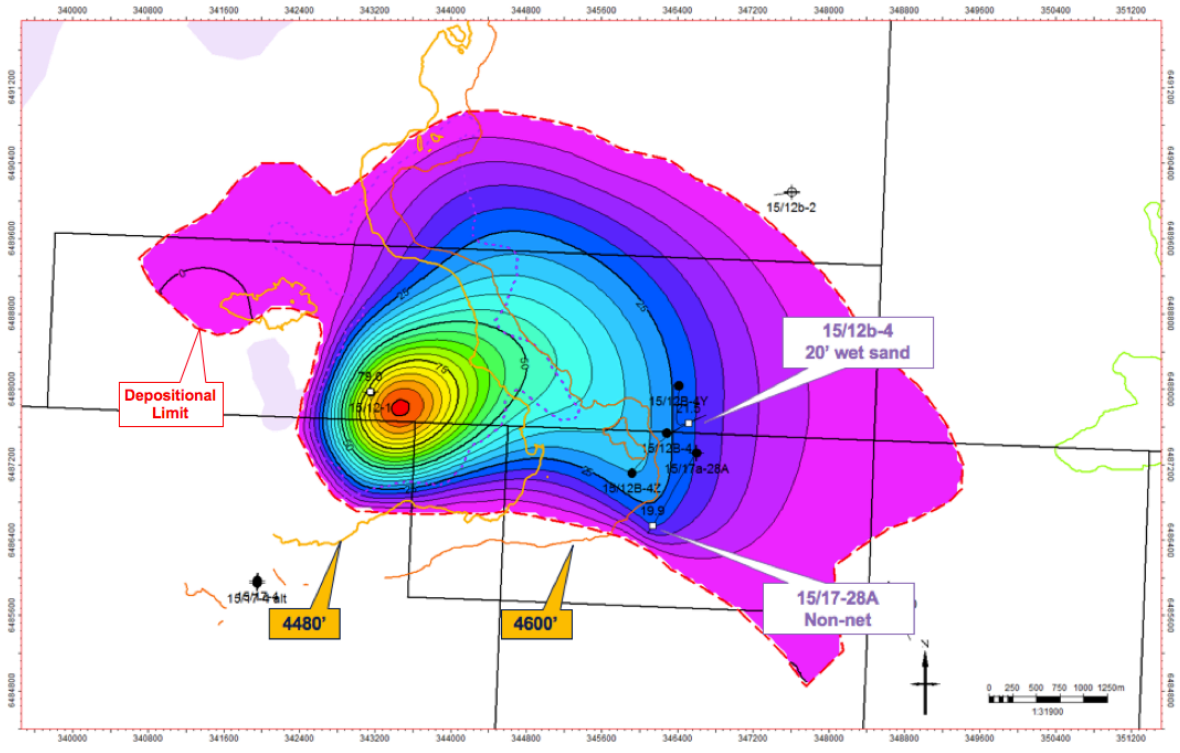


Figure 6-12: Beaumaris reservoir sand gross thickness from well data, with depositional limits from seismic

The amplitude of the top Beaumaris reservoir pick is shown in Figure 6.13 draped on its TWT surface. This shows an area of higher amplitudes centred around the Beaumaris Discovery well, with localised conformance to structure on its southern flank. The presence of gas chimneys disrupt the bright amplitudes.

The top reservoir map (Figure 6.8) was depth converted using a single layer V_0-*K* depth conversion. A preferred two-layer model with top Dornoch as the other boundary was difficult due to the lack of local log coverage.

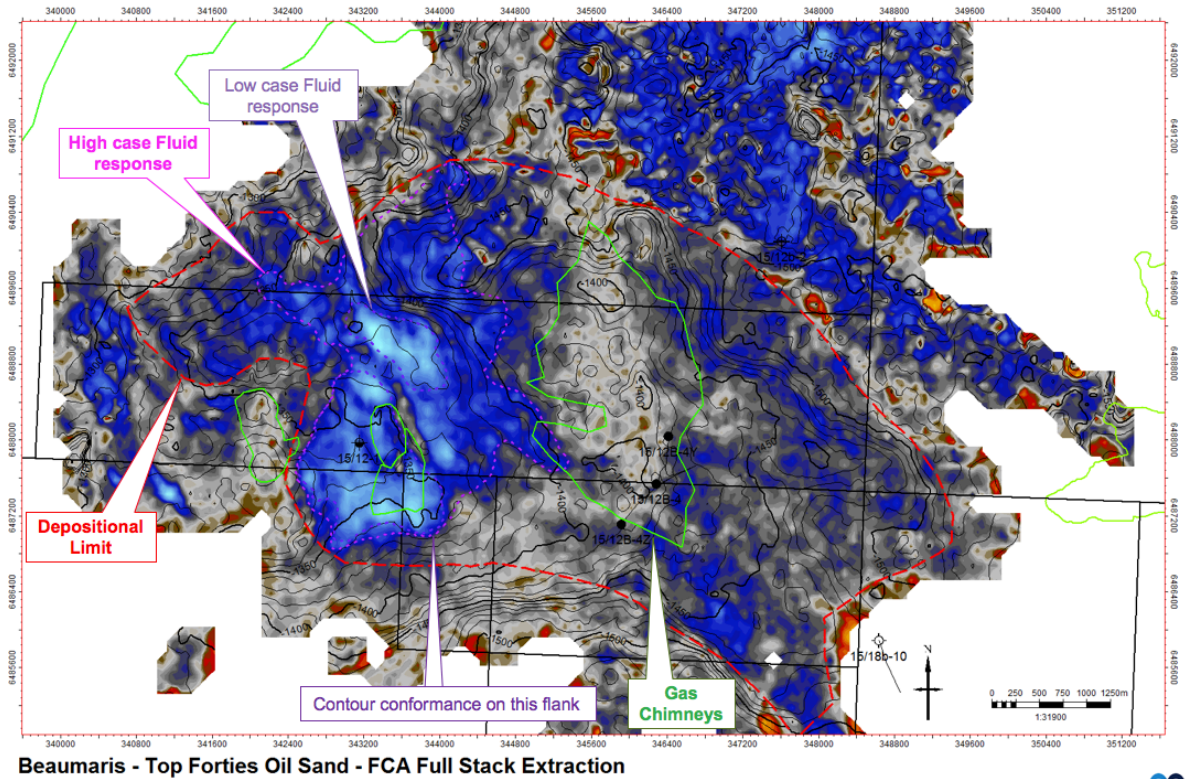
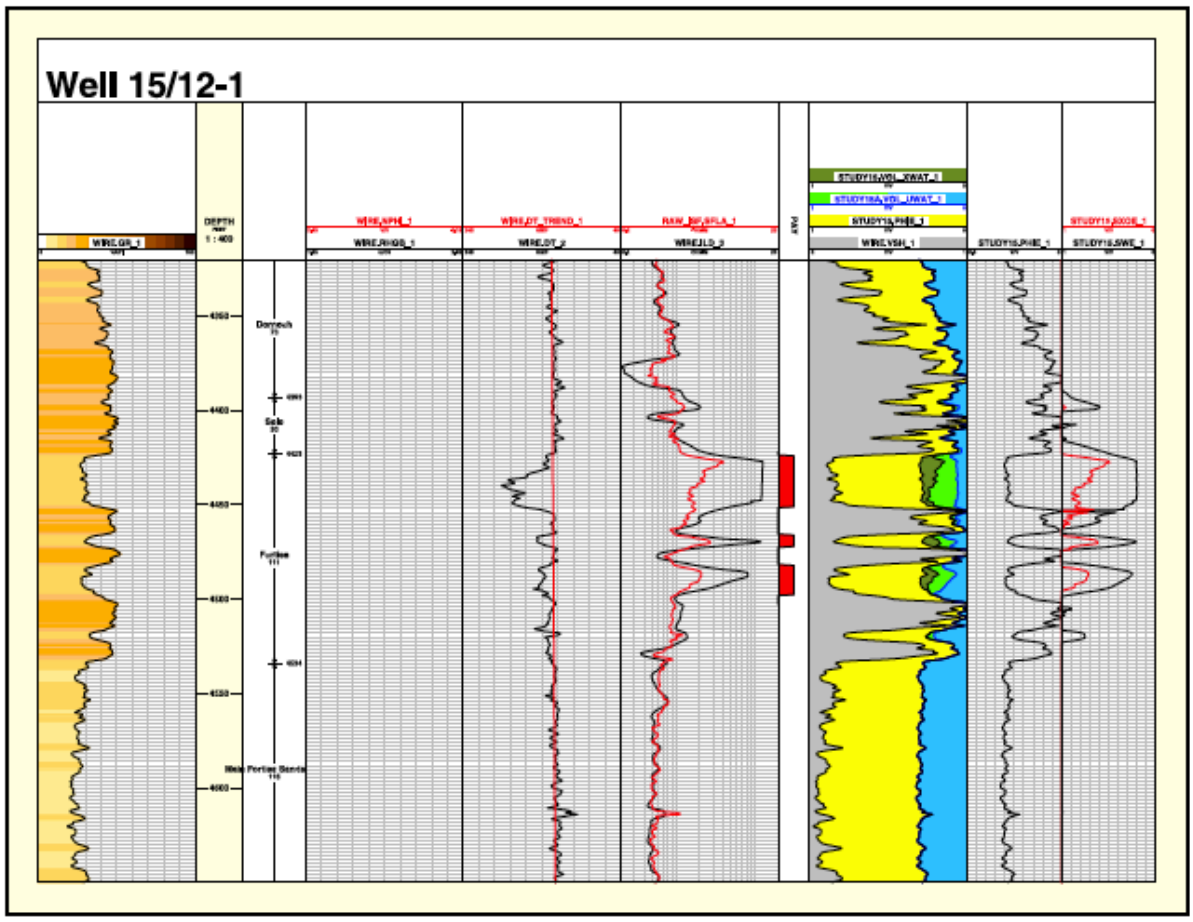


Figure 6-13: Top Beaumaris reservoir TWT surface with drape of Instantaneous full stack amplitude

6.2.2 Petrophysical Evaluation

Log analysis of the 15/12-1 well confirms *ca.* 50 ft of net oil pay in 28% porosity sands (Figure 6.14). Resistivity logs indicate a flushed zone, which along with the SP log suggests reasonable permeability. Well test analysis was reported as suggesting low permeability sands; though there is little information on the test.



	INTERVAL	Top	Base	GROSS	NET	N:G	poro	Sw
15_12-1		4422	4503	81	50	0.617	0.277	0.314

Figure 6-14: CPI of well 15/12-1 (Beaumaris Discovery)

6.2.3 Fluid Properties

Analysis of a sample from DST suggests a 17-18° API oil, with one sample note indicating 0.39% sulphur. It is likely that the sample quality is poor. No viscosity measurements were reported.

The reservoir is at *ca.* -4,350 ft TVDSS and therefore the oil is expected to be biodegraded. It is located 12 km updip, and is *ca.* 900 ft shallower, than the Maria Discovery, which has a viscosity of 12 cP. A regression of the local viscosity-depth trend predicts a viscosity of 40cP at Beaumaris, using wells 15/13a-10, 15/18b-11, 15/18a-12, and 15/19b-10. A range of 20-70 cP is suggest taking qualitative factors into account.

6.2.4 Volumetrics

Sixteen deterministic cases were run to test the sensitivity of the seismic interpretation and the uncertainty of the OWC on the volumes. This tested the following interpretation variables:

- Extent of seismic amplitude;
- Isochore method (seismic, well, and 60 ft constant slab);
- Depth of OWC.

Reservoir properties were kept constant using the petrophysical data from the discovery well. The Best technical case along with Low and High cases are given below in Table 6.2.

Cases	OWC feet TVDSS	N:G fr	Phi fr	So fr	Bo rb/stb	STOIIP MMstb	Contingent Resource MMstb	Ischore Used	Amplitude Polygon
Low Case	-4480	0.6	0.3	0.82	1.05	31	8	Well based	Strongest amplitude response
Best Case	-4480	0.6	0.3	0.82	1.05	59	15	Seismic trend	Weaker amplitude response
High Case	-4600	0.6	0.3	0.82	1.05	143	36	Seismic trend	Not constrained by amplitude response

Table 6-2: Beaumaris volumetric estimates

7 Further Technical Work Undertaken

The following additional work was carried out in the evaluation of Kildrummy, prior to the drilling of the 15/17a-28 well:

1. Biostratigraphic age dating was carried out to understand the relationship of the sandstones encountered in the Kildrummy Discovery to the Piper Field and surrounding area.
2. Two sedimentological studies to understand the depositional environment and controls on reservoir quality.
3. Both geocellular and reservoir models were built to model producer placement and determine resources from different Kildrummy seismic interpretation sensitivities.
4. Scoping facility studies were carried out for a tie-back to the Piper platform.

After the 15/17a-28 appraisal well and the down-side outcome, further facility sensitivities were examined, however, these failed to be sufficiently attractive. A facility study for co-development with Yeoman was carried out. This highlighted the need for a desktop study to evaluate the impact of mixing the 2 different crudes. However, given the modelled Kildrummy production profile, it would have been possible to produce the fields in series if there were issues with mixing the crudes, without significant loss in reserves.

Two separate rock physics studies were carried, out one for the Kildrummy evaluation and then one for the Beaumaris evaluation. The AI of the Kildrummy Sandstones is slightly higher than the Piper Sandstones, although the distributions overlap. The sandstones are generally acoustically harder

than the Jurassic silts, but again there is a strong overlap of distributions. There is *ca.* 5% increase in the AI of Kildrummy Sandstone due to oil pore-fill.

The Beaumaris rock physics study suffers from a paucity of nearby data, with the closest offset well with log coverage being the Maria Discovery, which is 1,000 ft deeper. In addition, no Forties discoveries were logged without a gas cap. The predicted seismic response with the overlying hard shale observed is a Class 2 AVO with the following magnitude of change: water = 1.2 x oil = 2.5 x gas.

Gathers from the GXT Kildrummy 2009 seismic display a Class 2 behaviour, though there are issues on the near angles. The Fugro PSTM+ gathers are unusual and have a peak at mid angles. The magnitude of the response seen at Beaumaris is similar to the Balmoral Field (oil/gas), with the Maria (oil/gas) response being 2.5 times higher than Beaumaris.

In conclusion it is not possible to be confident due to data paucity. The strong soft response is not consistent with the heavy oil at Beaumaris.

Spectral decomposition was used to assist in understanding the Tertiary depositional systems.

8 In-place Resource and Risk Summary

Table 8-1 below shows the predicted hydrocarbons in place and geological chance of success for the opportunities within the licence. The 75% geological chance of success assigned to the Beaumaris Discovery is to capture the productivity uncertainty associated with the resources, since minimal flow was achieved on test.

Resource and Risk Summary									
Prospect Lead Discovery Name	**PLD**	**Stratigraphic Level**	**Unrisked resources in place**						**Geological Chance of Success (%)**
			Oil (MMbbls)			**Gas (BCF)**			
			Low	**Central**	**High**	**Low**	**Central**	**High**	
Kildrummy	D	Upper Jurassic		9.7					100%
Udny	P	Upper Jurassic	0.8	7.6	75.7				70%
Beaumaris	D	Forties	31	59	143				75%

Table 8-1: Summary table of STOIIPs and geological chance of success

9 Conclusions

The Kildrummy Discovery is too small to economically viable as a standalone tieback to the nearby Piper Field. It is possible that it could be developed as part of a cluster tie-in with Beaumaris and/or Yeoman/Pardis. The Beaumaris Discovery requires additional appraisal to determine productivity and obtain a fluid sample. It should be noted that had not been identified by the licence partnership as a viable discovery until oil prices were low.

The Udny prospect, whilst low risk in the downside and mid case, is considered too small to be economically viable.

10 Clearance

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